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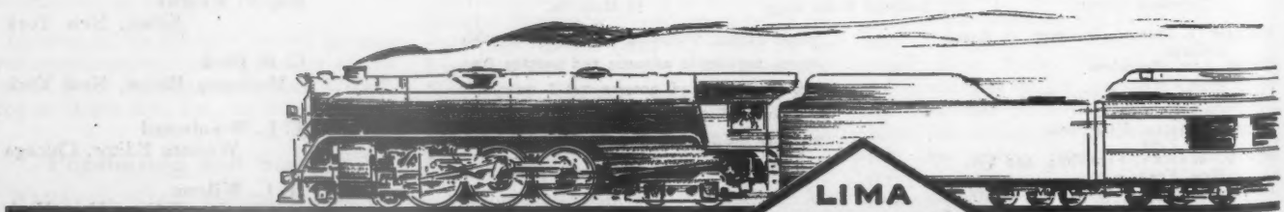


LIMA LOCOMOTIVE WORKS INCORPORATED

LIMA OHIO

Railway
Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal

October - 1934

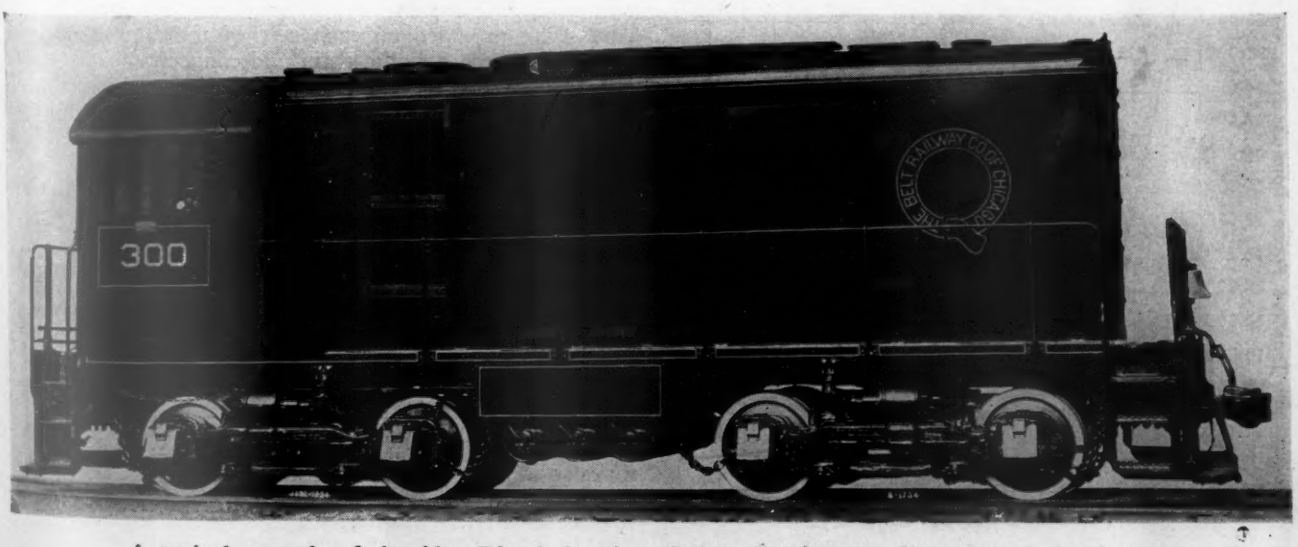
Alco Builds Diesel-Electric Switchers with 600-Hp. Engines

Single-end cab units built from same basic design for several roads are powered with McIntosh & Seymour Diesel engines. Power trucks with two traction motors each have unusual design providing for positive equalization

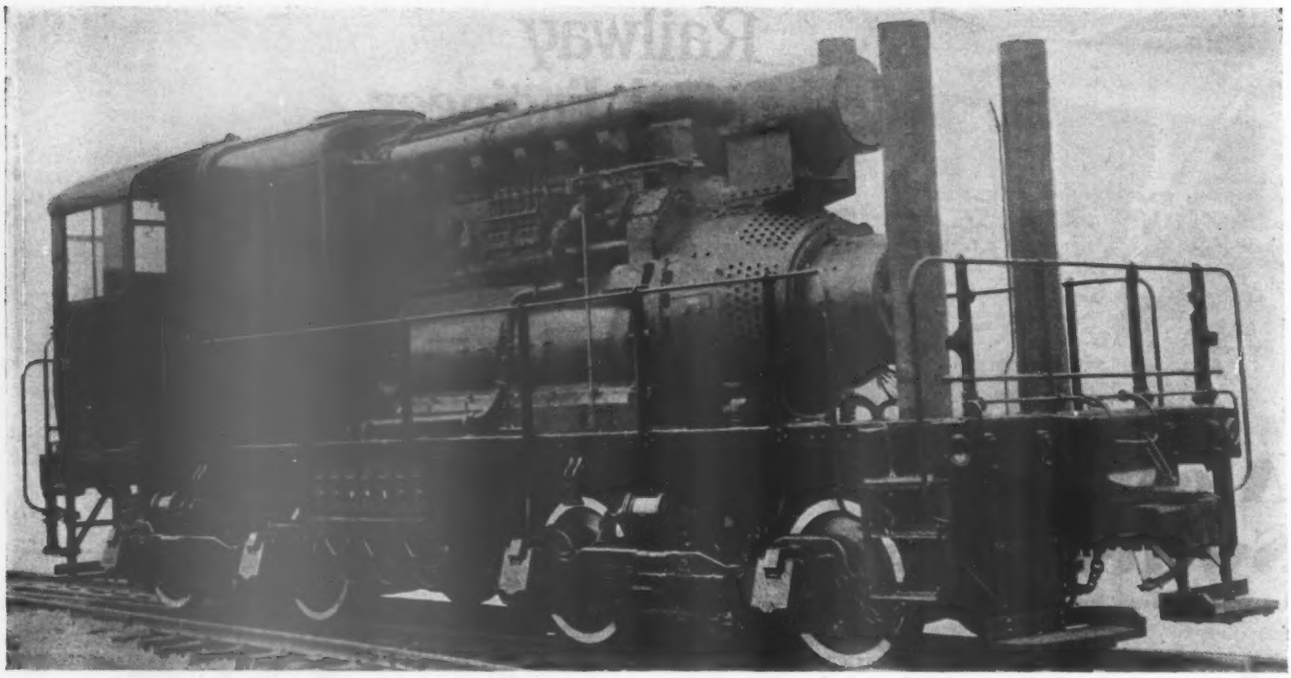
DURING recent months the American Locomotive Company has built several Diesel-electric switching locomotives for different roads having a total weight of 200,000 lb. and a starting tractive force of 60,000 lb. A typical design, built for the Belt Railway of Chicago, is shown in one of the illustrations. One each of the same basic design has been built for the New York, New Haven & Hartford, the Lehigh Valley and the Boston & Maine, and eight have been built for the Lackawanna.

Two four-wheel power trucks having a total of four traction motors carry the entire weight of the locomotive, and the engine and generators, built as a unit assembly, are mounted on underframes either of cast steel or built-up structural design as the preference of the individual roads dictates. The two power trucks and the engine and generator assembly comprise 125,400 lb. of the total 200,000-lb. weight of the locomotive. The general dimensions and the principal weights are given in Table I. The operator's cab is at the end and the equipment hood, covering the engine and generators, is designed to provide maximum visibility for the operator and complete accessibility to important parts. The radiators are under a portion of the hood next to the cab, and the forward hood, covering the engine unit, is readily removable for access to the engine and generators when major shop repairs are necessary.

In 1929 the American Locomotive Company purchased the McIntosh & Seymour Corporation, an old and well-established concern noted for its modern heavy-duty marine and stationary Diesel engines. Through the coordination of the Diesel experience of the McIntosh & Seymour Corporation with the American Locomotive



A typical example of the Alco Diesel-electric switcher—built for the Belt Railway of Chicago



The forward hood is readily removable providing accessibility to the engine and generator. The radiators are seen directly ahead of the cab and the columns at the forward end are the sand boxes

Company's knowledge of general railway conditions of operations and their facilities for maintenance and repair, a special line of Diesel engines peculiarly adapted for railway use was perfected.

The Alco type McIntosh & Seymour Corporation 600-hp. Diesel engine for locomotive service has six cylinders cast in one block and is of the vertical four-cycle, single-acting type. This engine is rated at 600 b.hp. at 700 r.p.m. Its idling speed is one-half of the normal running speed, or 350 r.p.m. Each of the six cylinders has a bore of 12½ in. with a piston stroke of 13 in. These dimensions and a normal speed of 700 r.p.m. give a brake mean effective pressure of 70 lb. per sq. in., and a conservative piston speed of 1,515 ft. per min.

The cylinder block of cast iron is arranged to include water jackets of ample capacity with free circulation. Removable cylinder liners are used in order to protect the cylinder block. The cylinder liners take the wear and may easily be replaced when necessary.

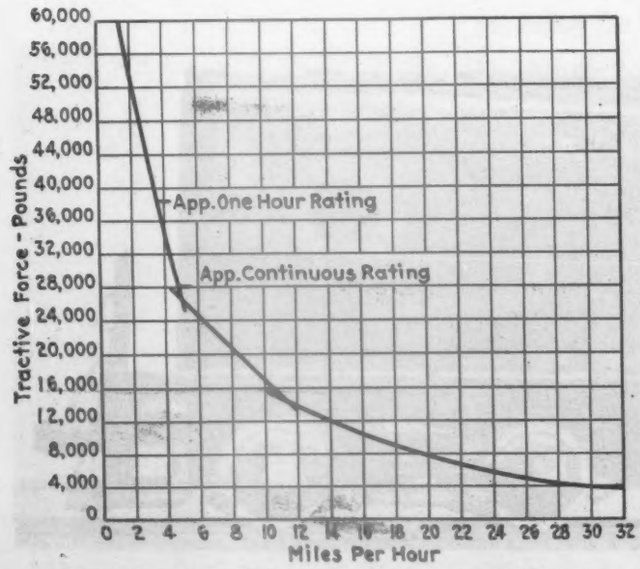


Chart showing relation of speed to tractive force

Individual cylinder heads of cast iron are used. These have a uniform section, are water jacketed and are secured to the cylinder block by heavy studs. Two exhaust valves, two intake valves and one injection nozzle are symmetrically located in each cylinder head. The injection nozzle is located in the center of the cylinder head and is designed to give proper fuel atomization. The valve gear is of the rocker type and is totally enclosed and pressure lubricated. The valve springs are suitable for heavy-duty operation.

The cam shaft is of suitably treated steel with integral cams accurately fitted. The cam shaft may be removed from the engine in one piece. The shaft is rigidly supported and driven from the crank shaft by gears.

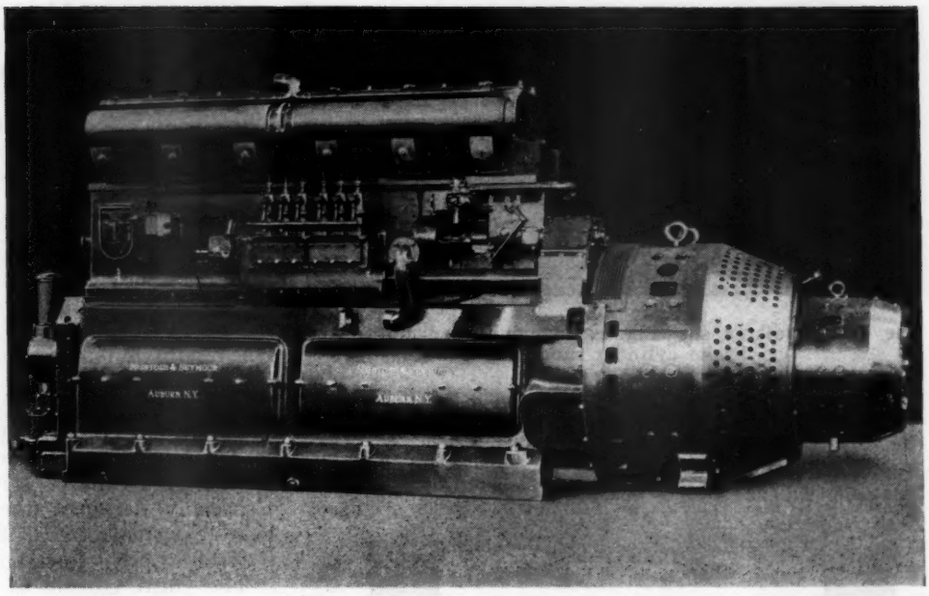
The engine frame is of the integral base type; that is, the frame supporting the engine bearings and the frame supporting the generator is all in one piece. This is of cast iron designed for heavy duty service. Detachable covers are provided on each side of the engine frame, giving free access to the main and connecting rod bearings. These openings are exceptionally large. In the base of the engine frame is a lubricating oil reservoir containing 100 gallons of lubricating oil, which is generally changed every three months.

With this type of construction the total weight of the Diesel engine alone is 35,000 lb., or only 17½ per cent of the total weight of the locomotive which is 100 tons.

The main bearings are rigidly located in the engine

Table I—General Dimensions of Alco Diesel-Electric Locomotive

Length overall, inside coupler knuckles	40 ft. 10 in.
Width, overall	10 ft. 3½ in.
Height, from rail (maximum)	14 ft. 5 in.
Truck-center distance	27 ft. 4 in.
Truck wheel base	8 ft. 0 in.
Truck wheels, diameter	3 ft. 4 in.
Total weight of locomotive	200,000 lb.
Weight of engine, generators and bed	49,000 lb.
Weight of one truck, complete with motors and brake rigging	38,200 lb.
Total weight on drivers	200,000 lb.
Tractive force (starting)	60,000 lb.
Maximum speed	40 m.p.h.
Minimum radius curvature (locomotive alone)	50 ft.



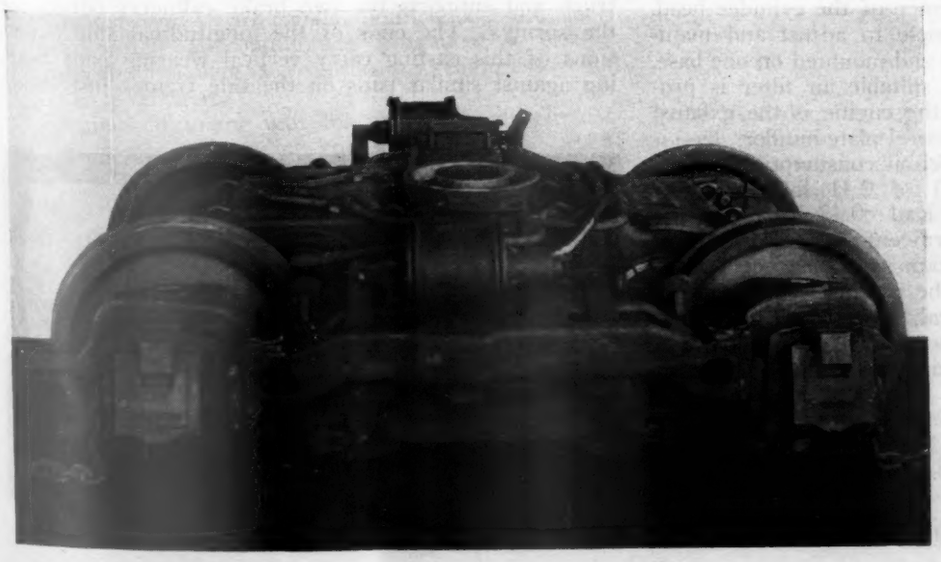
The injection side of the 600-hp. McIntosh & Seymour engine showing the unit pumps which supply fuel to the nozzles. The generators are direct driven from the main shaft

frame. The bearing shells are of bronze and lined with babbitt metal. The bearing caps are of cast steel and accurately fitted. The bearings are bored and reamed with the caps in place. The crank shaft has six throws and is of heat-treated steel accurately fitted in seven main bearings. The crank-pin diameter is 8¼ in. and the length, 6 in. The main bearing diameter is 9½ in. and the length, 5½ in. The engine has an exceptionally large crank shaft, thereby eliminating any serious tortional vibration within the working range.

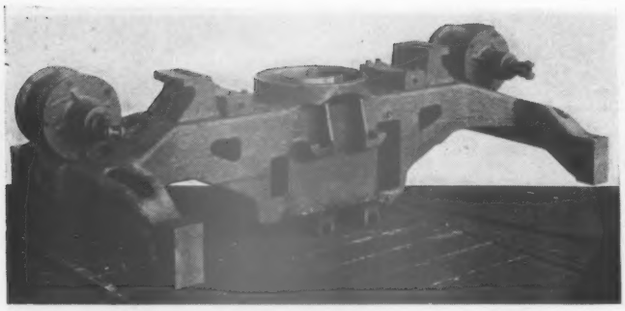
Connecting rods are designed of forged steel. The crank-pin bearing shells of bronze are lined with babbitt metal. Bearing caps of forged steel are accurately fitted to each rod. The piston end of the rod is fitted with a bronze bushing for the wrist-pin bearing. The rods are rifle-drilled to carry lubricating oil from the connecting-rod bearing to the wrist-pin bearing. The floating steel wrist pins are accurately ground to size. The wrist-pin-bearing diameter is 6 in. and length, 5 in. The trunk type pistons are of cast iron and ground to size. The piston rings are of cast iron. There are five compression rings and two lubricating oil wiper rings. This number of rings not only maintains high compression, but also keeps the lubricating-oil consumption down to a minimum.

The lubricating-oil pressure is maintained by a heavy-duty gear type pump located in the base of the oil sump. This oil is forced through the cooling radiator and then through a strainer to the main bearing, then through the crank shaft to the crank pin and on up through the connecting rod to the wrist pin, where it is forced out and drops down to the reservoir. The centrifugal type water pump is mounted on the side of the engine and forces the water through the cylinder jacket out through the top of the cylinder heads to the top of the radiator and returns to the water pump from the bottom of the radiator. The radiator sections for the water cooling and lubricating-oil cooling are mounted in the same unit. The air is forced through this radiator by an electrc motor-driven fan. The fan speed is regulated by the locomotive operator and has four positions—stop, slow, medium and fast.

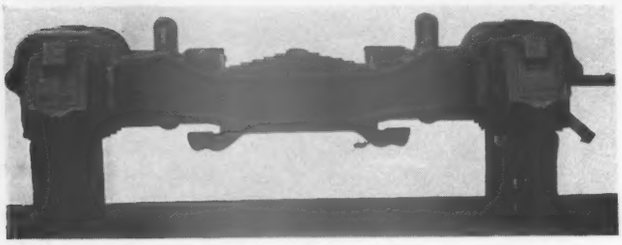
The engine governor is of the centrifugal variable speed type and is mounted on the side of the engine. The operator's throttle lever controls the setting of the governor between idling and full speed. The governor controls the setting of the fuel injection pumps. In other words, the operator has control over the engine speed only, while the governor has complete control over the fuel supply. By this method the engineer is



The complete truck, weighing 38,200 lb., is designed to provide positive equalization regardless of uneven track conditions and, with the brake rigging outside of the side frames, permits brake adjustments and replacements to be made without undue loss of time



The truck bolster showing arrangement for motor and brake cylinder mounting



The truck equalizer is a steel casting housing the spring and forming the journal box pedestals

not only controlling engine speed, but also engine maintenance which is directly proportionate to engine speed, thereby keeping both at a minimum in proportion to the horsepower actually delivered. The fuel injection system is of the Bosch type which uses a separate injection pump for each cylinder. The six pumps are mounted in one unit on the side of the engine opposite the governor. The small cam shaft is used to operate these pumps which have a constant stroke. However, the quantity of fuel is varied by the governor controlling the by-pass valve on each pump. Incorporated with the injection system is an automatic safety device which shuts the fuel off if the lubricating-oil pressure drops below normal. The fuel oil is pumped from the fuel-oil tank from the locomotive up to the fuel injection pump by a small motor-driven fuel pump. The fuel oil is forced by the fuel-injection pump through a special steel pipe to the fuel injection nozzle previously referred to as located in the center of the cylinder head. This system is extremely simple to adjust and maintain, as all pumps are identical and mounted on one base.

An air intake header with suitable air filter is provided. On the other side of the engine is the exhaust header which enters the heavy steel plate muffler.

The Diesel engine has a fuel-oil consumption (based on 19,000 B.t.u. per pound) of 0.41 lb. per brake horsepower per hour at full load; 0.42 lb. per brake horsepower per hour at 75 per cent load, and 0.46 lb. per brake horsepower per hour at 50 per cent load. With this fuel consumption the exhaust will meet any smoke requirement of federal, state and municipal authorities. The fuel oil recommended with this Diesel engine has the following specifications.

Heat value (B.t.u. per pound)	Minimum 18,500
Baume at 60 deg. F	Minimum 26
Flash point, deg. F	Minimum 150
Viscosity Saybolt universal (Seconds at 100 deg. F)	Maximum 60
Water and sediment	Maximum 1 per cent
Carbon residue	Maximum 1 per cent
Sulphur	Maximum 1 per cent

(Fuel oil should be wholly an overhead product.)

Electrical Features

The electrical equipment consists primarily of the main and auxiliary generators and the traction motors. The main and auxiliary generators are overhung from the engine and driven by the main engine shaft. The main generator is a General Electric DT-526 of the differential-field-control type having characteristics especially adapted to switching service. The auxiliary generator is of the constant-voltage type (125 volts) maintaining this voltage regardless of engine speed. This generator furnishes current for the charging of the 56-cell, heavy-duty storage battery for starting the engine as well as power to such auxiliaries as the 100-cu.-ft. air compressor, radiator-fan motor and traction blower motor.

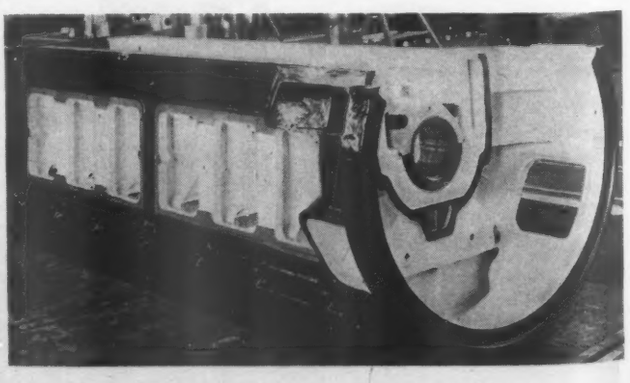
Four single-geared commutating-pole type traction motors, class GE-287, are supported on the truck axles, to assure gear and pinion alinement, and on the truck bolster by means of a motor nose on spring supports. Especially designed for switching service, the motor losses, particularly at high tractive forces, are relatively low per kilowatt of power input.

The entire control of the locomotive is embodied in the operator's throttle which simply regulates the speed of the Diesel engine. Reversal is effected by a master controller. The motors operate in series at low speeds and are automatically changed by a voltage relay to series parallel. By automatically shunting the fields of the traction motors higher running speeds are obtainable, but the operator may forestall the higher running speeds by setting the electrical controller on the series or series-parallel position.

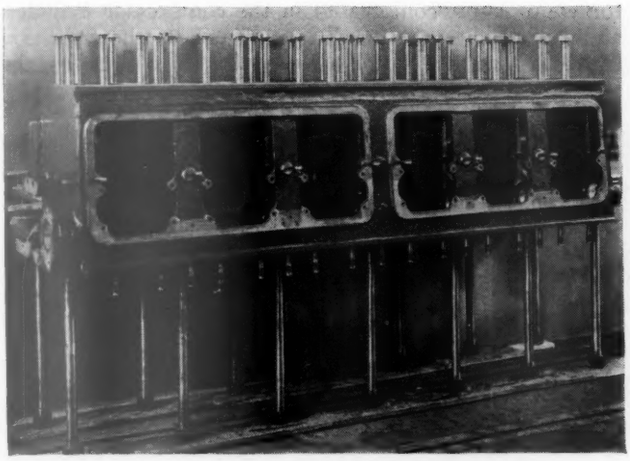
Underframe and Trucks

The underframe generally is of cast steel construction, but some locomotives of this type have underframes fabricated of structural shapes and plates welded into a single structure with cast steel bumpers at the front and rear. Standard A.R.A. couplers and pockets are used.

The power trucks, two in number, are of the four-wheel center bearing type having a special design of cast steel bolster. Each truck equalizer, or what in this case may more properly be termed the side frame, is a steel casting, at each end of which is the truck-box pedestal. Single, long, semi-elliptic springs, one suspended by hangers in each side-frame casting, carry the load. The bolster casting is designed to form the nose mounting for the two traction motors on each truck and supports the two brake cylinders outside of the springs. The ends of the longitudinal side extensions of this casting carry vertical wearing pads bearing against similar pads on the side frames just inside



The crank case and engine bed



The cylinder block

the truck boxes. These keep the truck square in horizontal alinement without interfering with vertical flexibility.

The principal feature of this truck is that the construction provides for positive equalization at all times without the distortion of any truck members regardless of any uneven track condition. The low side frame and absence of end frames allows ready accessibility to the inspection covers and oil reservoirs of the traction motors. The brake rigging is all placed on the outside of the truck so that brake adjustments, inspection and brake shoe renewals can be made with a minimum loss of time.

The axles are of open hearth forged steel finished for truck and motor bearings, wheel and gear fits, and the journals are 7 in. by 14 in. The rolled steel wheels are 40 in. diameter.

Cab and Fixtures

The operator's cab is of the single end type with a removable hood covering the Diesel engine and generator. The fuel oil tanks are of 400 gallon capacity and the cooling water tanks have a capacity of 50 gallon. Four sand boxes are provided and the sand is delivered to the rail by means of pneumatic sanders. Electric cab heaters are provided.

Performance

Of the several railroads on which locomotives of this type have been in switching service for some time, two have furnished data on fuel and oil consumption and maintenance for a full year's operation. On road A the fuel consumption averaged 5.22 gallons per hour and lubricating oil .0696 gallon per hour for a total of 7,609 hours. The locomotive was in the shop 10 days for a yearly overhaul, on which 568⅙ man-hours were expended, of which 257½ man-hours were on the Diesel engine, 249⅔ man-hours on other mechanical equipment, including wheels turned, and 61 man-hours on electrical equipment. On road B the fuel consumption averaged 5.93 gallons per hour and the lubricating-oil consumption .0757 gallon per hour during 8,082 hours of service. This locomotive was in the shop two weeks for its annual overhaul. The Diesel engine accounted for 194 man-hours; other mechanical equipment, including wheels turned, 265 man-hours, and electrical equipment, 112½ man-hours—a total of 571½ man-hours during the shopping.

New Haven Installs Air-Conditioning in 69 Cars

Carrier-Safety units accomplish the distribution of air without the use of ducts

A TOTAL of 69 passenger cars equipped with Carrier-Safety air-conditioning equipment have recently been placed in service on the New York, New Haven & Hartford. Of these 57 are de luxe coaches and smoking cars and 12 are combination baggage and smoking cars. The air-conditioning equipment is electro-mechanical employing a reciprocating compressor and Freon as a refrigerant.

The air-conditioning unit containing the air circulating fan, motor and cooling coils, heating coils, expansion valves and outside and return air filters is located in the clerestory at the center of the car.

Air Distribution Accomplished Without Ducts

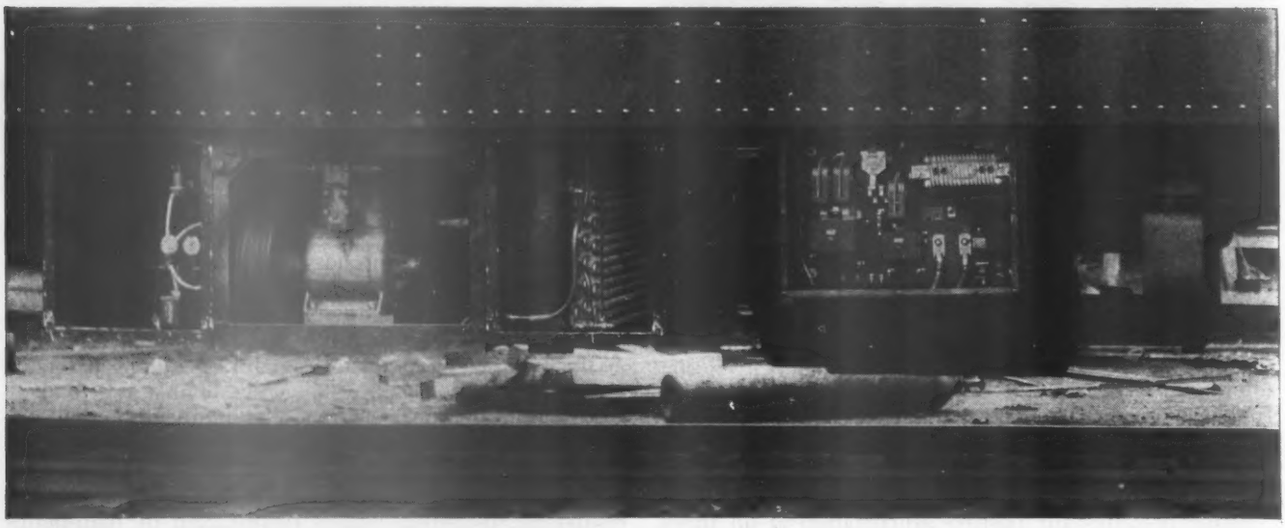
The air distribution in all the cars is by delivery without ducts direct from the air-conditioning units. In the coaches and smokers the air-conditioning unit is placed in the center of the car and delivers air in both directions. In the baggage-smokers the unit is placed on the baggage compartment side of the partition and delivers air in one direction only.

There are two sets of fans in the coach units, driven by V-belts from a single motor. These fans draw air from outside the car through filters, located in the deck-side, and air from the car through filters placed over a grille located under the unit. The air from the fans is forced through the heating and cooling coils, and through the special distribution plate into the car. This plate is so designed that the air issues into the car with sufficient velocity to reach the end of the car, but to cause no objectionable drafts. The units circulate 2400 cu. ft. of air per minute, 600 of which is taken from outside the car.

The air-conditioning units in the baggage-smokers are similar to those in the coaches except that there is only one set of fans and coils. These units circulate a total of 1200 cu. ft. of air per minute. The return air grilles in these cars are mounted vertically in the partition between the passenger and baggage compartments.

Control of the temperature of the cars is accomplished by starting and stopping of the refrigeration unit by means of a thermostat. Heating coils are placed in the

air-conditioning unit so that when the fans are used for circulating air in cold weather the air may be delivered to the car at a comfortable temperature. Control of the car temperature both for cooling and heating is accomplished by the Vapor Car Heating Company's centralized control.



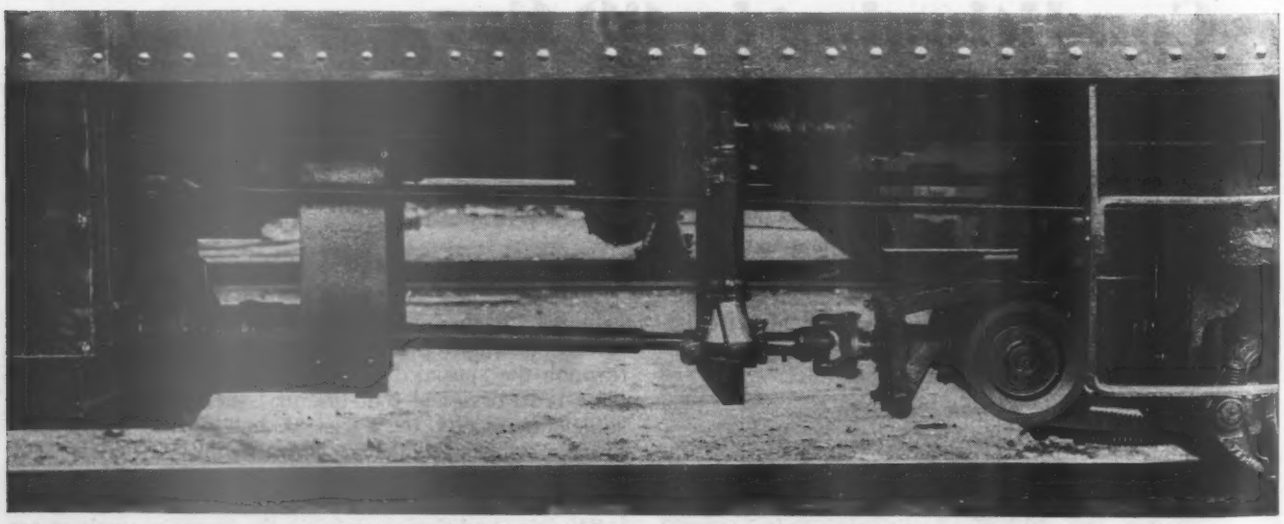
The refrigerating unit is beneath the car floor

The Refrigeration Unit

The refrigerating unit, composed of the compressor, condensers, condenser fans, liquid receiver and liquid subcooler, with the motor for driving the compressor and condenser fans, is located beneath the car floor. The necessary connecting pipes between these units are run between the car sheathing and the inside finish.

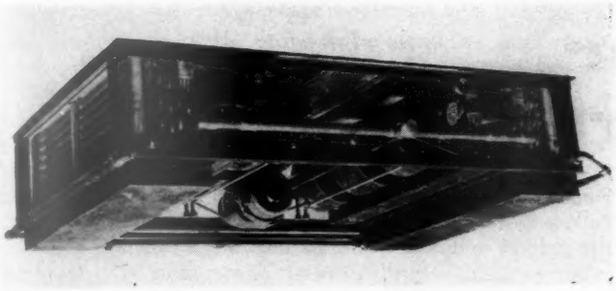
During the operation of the system liquid refrigerant is supplied to the cooling coil in proper amount by the expansion valves. The heat absorbed from the air circulated over these coils by the air circulating fan evaporates the refrigerant.

This refrigerant vapor is drawn off by the action of the compressor, compressed in the compressor cylinder, and delivered to the condenser, where by the reduction in its temperature in the air-cooled condenser tubes, the vapor is liquefied and passes to the condenser. As refrigerant is needed to supply the cooling coil, the liquid passes from the receiver to the expansion valves. Between the receiver and the expansion valves is the liquid subcooler, which further reduces the temperature of the liquid refrigerant. The liquid subcooler is a coil of tubing placed in the air stream from the condenser fan. The condensed water from the circulating air which forms on the cooling coils of the air-conditioning unit is piped to one of the condenser fans, where a slinging device mounted on the motor shaft sprays the water over the subcooling coil. The evaporative cooling thus obtained reduces materially the temperature at which the liquid refrigerant is delivered to the expansion valves.



The generator drive from the gear box by means of shaft and universal joints

Liquid subcooling which is a feature of the Carrier-Safety equipment makes a material reduction in the power required by the compressor, since the power



The ceiling unit with cover plates removed

required for a given refrigerating capacity will decrease as the temperature of the liquid delivered to the cooling coil is lowered. With this particular equipment a saving of 10 per cent is said to be accomplished. The compressor is driven from the motor by a multiple V-belt drive. The condenser fans, two for each unit, are mounted directly on the motor shaft. The coaches and smokers have a four-cylinder compressor operating at 300 r.p.m. at normal voltage. The capacity of equipment is seven tons. The baggage-smokers have a two-cylinder compressor operating at 400 r.p.m. and a capacity of five tons.

Interior of the car showing air-conditioning unit in the clerestory

The Power Supply

To supply the power for operating the cooling system and lights, a 15-kw. generator (375 amperes at 40 volts) has been applied to operate in parallel with the 4-kw. generator already on the car. Current for operation when the car is running at low speed or is stationary is supplied by a 1000-amp. hr. storage battery, consisting of 16 cells of Exide EPTT 41. The generator output is controlled by the standard Safety type of carbon pile regulator and relay, with battery protection by taper charge control.

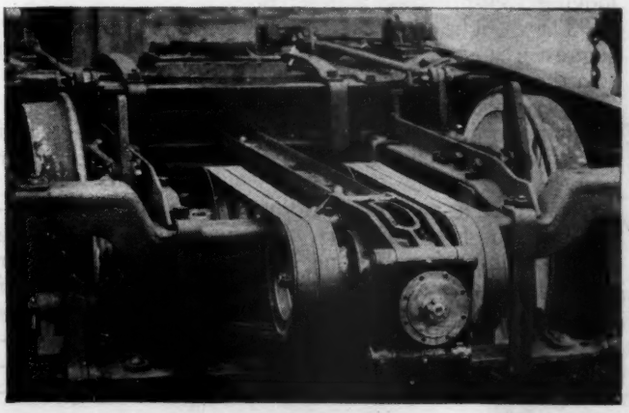
The Generator Drive

The 15-kw. generator is driven from the car axle by a Dayton-Roderwald combination V-belt and gear drive. A pair of driving pulleys, each pulley driving two 2-in. V-belts, is mounted on the axle. These belts drive similar pulleys which are mounted on a shaft extending from either side of a gear box, mounted on the endsill of the truck. This gear box is so arranged that it may swing to keep the proper tension on the belts. Tension is furnished by a spring which swings the gear box away from the endsill.

Mounted in the gear box are bevel gears which transform the rotation 90 degrees, bringing it about an axis parallel to the longitudinal center line of the car. The speed of rotation is increased by the gears from that obtainable by the pulley ratio as limited by considerations of pulley size and clearance, to that necessary for operating the generator. From the gear box, the motion is transmitted to the generator by a driving shaft with universal and slip joints.

The axle pulleys are split and are applied to the axle over a layer of rubber which acts as a bushing. The gear box pulleys are not split, but are applied to taper fits on the shaft. All the pulleys are dynamically balanced.

The type of V-belt permits the use of a connector, making it unnecessary to use endless belts. Applications of the belts are made without the necessity of having an opening in the endsill or of lifting the axle out of the bearing box.



Dayton-Roderwald V-belt gear-box drive applied to the truck

A Clean Collar But No Shirt*

By Jno. C. Dice

Mechanical department employees must do their part in helping to get a square deal for the railroads. Otherwise their welfare will be jeopardized

"WHAT is a public relations program and how is the mechanical department identified with it?" asked a mechanical engineer of a representative who had just returned from a Public Relations Conference.

"The aim is to establish a feeling of harmony between our railroads and prospective passengers and shippers, so that both will benefit," was the answer. "The mechanical department has a part in it, just as every other department has. In big ways and little ways, at work, at home, everywhere, our endeavor should be to cultivate good will, to correct misrepresentation and actively to engage in furthering our railways' interests. The mechanical department ought to be especially alert to these things, considering the important improvements it has made, typical of which is the air-conditioned train."

Slogan for Air-Conditioned Trains

But not all mechanical department employees are so blind to the aims of a public relations program as this one appeared to be. Recently one of them boarded one of his road's air-conditioned trains. Warm, perspiring, crumpled-looking, he hastened to clean up. When he returned he sank with a grateful sigh into his chair, looking well-groomed and serene.

"They ought to allow the mechanical department to suggest a slogan for these trains," he said, "I can travel two thousand miles on them on a clean collar."

"Two thousand miles on a clean collar!"

That is quite a slogan and in it is contained the gist of the railroads' public relations endeavor—to give of their best.

However, a passenger riding in the finest air-conditioned car, free from dirt, on a sweltering day, can be made so uncomfortable and hot under that clean collar by a short-tempered and morose conductor that all of the money spent by the company on equipment for his convenience has been entirely thrown away. The careful planning of the mechanical department and the forethought of the executives who provided this modern comfort, have been absolutely annulled by the careless word, lack of initiative or lack of attention of the company's representative, whoever he may be. No matter how much his road advertises that it is always springtime in these air-conditioned cars, the torrid zone is cool in comparison, from the passengers' viewpoint. Instead of the latest and best in equipment having gained a friend, the stupidity of the human element has added an enemy.

Our fine air-conditioned cars are built to certain standard specifications, but the human element having charge of these trains is not. Each is only an average man, who at times sees no reason why he should have patience with unreasonable people, or display a courteous demeanor, when he does not feel like being bothered. Happily, such treatment occurs only at rare intervals, but when it does, it leaves a slime of discord.

So, apart from equipment that gives the public comfort and establishes safety records, the public relations representative in the mechanical department must realize that it is in his contacts with the public that true understanding is born.

Little Things Count

Men from the mechanical departments have occasion to ride the trains frequently. One was returning recently, apparently relaxed and oblivious to his surroundings. Then he spoke.

"The lamp of that third light isn't of the same composition as the others," he told his companion. "It's too dark. It doesn't look good. When this car gets back to Cincinnati see that it is fixed."

That man knows that the little things make big things and he sees them from the public's angle. He has his job on his mind at all times. He would make a good public relations representative. He loves his job. But many a man who loves his job wouldn't make a good public relations representative. He must do more than love his job. He must understand its relation to the public.

What is this public that he must understand? Is it a reasonable body? Is it always courteous and clear thinking? Has it absolute integrity? Is it unselfish and just? Well, we are a part of this public, you and I, and so is all the rest of this population with its varying interests and its degrees of education and culture, both mental and moral. To work with it in successful public relations endeavors it is necessary to be adaptable, and to give what we would like to receive. When we go into a store we wish to be waited on with courtesy. We

* We have had a number of interesting reactions to the interview with the Public Relations Officer in our August number. Among them is this article by Mr. Dice, who is assistant to vice-president, Chesapeake & Ohio.

wish the upkeep of the store to be attractive and up-to-date. We wish the stock it sells to be up to standard.

But as a part of the public, we know that for all of the satisfaction we expect and have granted us in dealing with that store, if we experience one bit of carelessness or rudeness on the part of even a janitor or delivery boy, we are apt to explode, carry a grudge and declare that we shall never deal there again. The traveling public is just the same, and so is the shipping public, and we must have understanding in dealing with it.

Public Relations Program Must Be Positive

However, to be negative in putting over a public relations program is not what is needed at this time. It is not so much a question of being courteous in order not to make enemies as definitely to cultivate good will in order to make friends.

Friends are needed.

Now, these friends. Wherein are they friends? How may they be recruited?

There are none so bluff, even in this hale and hearty manner of making a living called railroading, who does not know the value of a friend.

A man is a friend when he stops saying, "Yes, the railroads have had a tough time of it," and says instead, "What shall we do to obtain fair treatment for the railroads."

Such friends are among the acquaintances of the mechanical department employee. They belong to his church, his lodge, they gossip with him in the corner store, they are all about him. Some of them may be running for office from his district or know men who are. If he never discusses vital interests with them, they may think of him as the sort who knows no more about his railroad job than that he performs his daily routine.

That man who is running for office. How does he feel about railroad issues? He represents this mechanical department employee in Congress or the state legislature. His work is not sacred. *We* send him to the House or the Senate. Then why does not the mechanical department employee go to him and discuss the problems which the railroads are facing. That is exercising the prerogative of an American citizen. He knows him, or should know him, and he will be glad to know the facts and do the things which common sense business demands. If not, the mechanical department employee and his friends must know someone who will be just and fair. Just as the light in the train that was out of harmony had to be replaced, so should he be replaced with one that will be in better keeping with the best interests of the railroad, the public it serves, and, never overlook this, the best interests of all who work for the railroads.

A robot is a mechanical man but mechanical men are no robots. They can think for themselves. What are they thinking of this threat of government ownership? Is it the other man's job to see that the public is awake to the perils of it and the injustice of it and prevent it? It is the mechanical employees' job that is threatened, along with that of every other employee of the railroads. Therefore, should they not see that their side is represented when this question is brought up? How will their side be represented? Well, whom are they going to elect to office?

The railroads have shown that they are anxious to please and serve the public. This has come about through the shortening of freight and passenger schedules, store-door delivery, and many conveniences and comforts provided the traveling public. The public has accepted these as their just due. A feeling of friendliness toward the carriers prevails. Many editorials have been written by those not connected with the railroads, championing their cause. These facts and others should be known by the mechanical department employee who is anxious to have his railroad represented in the proper light.

What the Railroads Want

All the railroads want is freedom of operation in comparison with their competitors.

They want only what is fair and right.

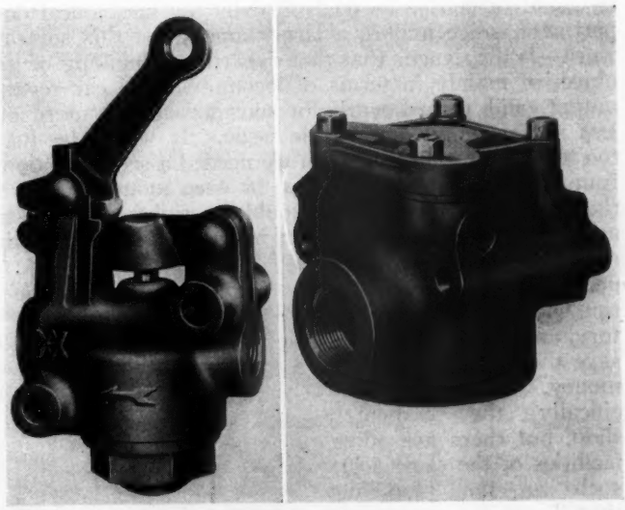
If they are to survive the threat of government ownership, the mechanical department employee and all other railroad workers must constitute themselves public relations representatives and step out and stop it. Unless they wish to obtain their jobs and their promotions through political favor, now is the time to elect men to represent them who will give the railways square legislation.

Here is a program for the mechanical department employee as he makes contacts. Two thousand miles on a clean collar won't help us much if we have lost our shirt.

B-3-B Conductor's Valve And Brake Application Valve

AN improved means of making brake applications by operation of the conductor's valve has been developed by the Westinghouse Air Brake Company to overcome the limitations of previous designs on long cars that have a large brake-pipe volume.

This new scheme involves the use of a large capacity Type E brake application valve, piloted by the B-3-B conductor's valve. The application valve is installed in a short branch pipe and connected by a small control pipe to the conductor's valve located at a convenient point. Operation of the conductor's valve quickly exhausts the small volume of air in the control pipe and the application valve immediately opens a high capacity vent from the brake pipe to the atmosphere.



B-3-B conductor's valve (left)—Type E brake application valve (right)

Co-operation Between Engineering And Mechanical Departments*

A Chief Engineer talks frankly with the Editor about the possibilities in this direction

THE engineering and mechanical departments have much in common and in many ways can be helpful to each other in the interests of the organization as a whole. Those who are familiar with this series of interviews, which was started more than a year ago, will recall that it is the policy not to advise the person to be interviewed in advance of the nature of the questions in the belief that immediate frank reactions are far more important and to the point for our purposes than more studied and carefully prepared statements. In other words, if the answers are not on the top of the mind and more or less automatic, the suggestions may not be very pressing or vital.

Combine Shop Facilities

"How can the mechanical department co-operate to better advantage with the engineering and maintenance of way departments?" I asked a Chief Engineer and maintenance officer of long experience.

"For one thing," he replied, "it seems to me that it is a mistake, and certainly not to the best advantage of the railroad as a whole, to have the engineering and the mechanical departments maintaining and operating separate facilities to do the same class of work. Take the carpenter shop, for instance. The same kinds of machinery and equipment are required for the work done by both departments, and yet too frequently each department maintains its own shop. One shop could be operated in the interests of both departments more efficiently and with a considerable saving in expense."

"Is it feasible to do this?" I asked.

"Yes," replied the Chief Engineer. "The difficulty in operating one shop for both departments—in which case it would of course be controlled by the mechanical department, since it does a larger amount of this sort of work—is the danger that that department thinking of its objective mainly in terms of locomotive and car repair output, will regard work for our department more or less as incidental and a side issue. It would be just too bad, for instance, if when we needed a set of window frames, we had to wait weeks, or even months to have the order put through. We could not rightly, of course, ask for unusual service, except in emergencies, but with reasonable attention to our needs. Such accommodation should prove satisfactory, and at the same time save the company a lot of money. I mention specifically the carpenter shop, but there are other facilities of the same sort, such as the plumbing shop."

"How about frog and switch work?" I inquired.

"My own point of view, and apparently that of many other chief engineers," replied the Chief Engineer, "is that the manufacturers are much better equipped to handle frog shop work, particularly since we have come to the use of manganese steel, and that it is more satisfactory and economical to have it done by them. There is, however, a certain amount of switch repair work and machinery repairs which is being done by the engineering and maintenance department, which I frankly believe can be handled to much better advantage by the mechanical department, if it will do the work promptly."

"Are there other ways in which the mechanical department can co-operate with you in the best interests of the welfare of the organization as a whole?"

Repair Work Train Equipment

"Yes," replied the Chief Engineer. "Our work train cranes and derricks are valuable pieces of equipment, especially in the busy season, and should be repaired promptly. Unfortunately, for some reason or other, this equipment sometimes has a tough time getting through the repair shop. I know of one road where great improvement was made in this respect when the mechanical department definitely set aside certain facilities and a certain part of the personnel for this work."

"Presumably that is the practice on most roads," I ventured, "at least where there is a sufficient amount of work to warrant so doing."

"It is true in some cases, but not all, by any means," said the Chief Engineer. "I wish also that when the locomotive and car shops are closed down, the shop in which the repairs to our equipment are being made, could be kept open, at least when we have particular need for it."

"Incidentally," continued the Chief Engineer, "there was a time when we had difficulty in getting suitable locomotives for our work trains. I am glad to say that conditions in this respect have changed and the mechanical department takes pride in seeing that we have that class of power which is best suited to the particular operations which we have in hand on a given day."

"What else have you to suggest?" I asked.

"Only one other thing," replied the Chief Engineer, "although I realize that it is a moot point and because of intangible factors it is difficult to make a clear case for the proposal. I would like to see the mechanical department install sectional scales, so that

* Fifteenth of a series of interviews with men outside the mechanical department, commenting in a constructive way upon the possibilities of that department.

we can ascertain accurately the weights on each pair of wheels of the locomotive. I may be all wrong, but it seems to me that if we had this information, adjustments could be made to distribute the weight more uniformly and prevent damage to the track. Certain roads, I understand, do have such scales and feel that the expenditure has been fully justified."

As I thanked the Chief Engineer for the courtesies extended to me, he reiterated that it was not his intention in any way to criticize his friends in the mechanical department.

"Indeed," he said, "I would like to see you interview a mechanical department officer as to how our department can co-operate to greater advantage with his. We, for instance, have the responsibility for such things as water supply and water softening and try to do all we can to be helpful to the mechanical department. It would be interesting, however, to know just what mechanical department officers would say if the editor of your Railway Engineering and Maintenance approached them for their ideas about how we could co-operate with them to better advantage."

Aerodynamics of the Railway Train

By Alexander Klemin*

Part III—Conclusion of a survey of wind-tunnel studies of head-end air resistance of locomotives and trains—General summary and conclusions

Experiments on a French Train

MAURAIN carried out experiments at the Institut Aerotechnique de St. Cyr[1] on a French train composed of a locomotive, tender, coach and box car, as shown in Fig. 11. The relative values obtained are of more interest than the actual coefficients.

Model	Coefficient in the form $K = \frac{R}{V^2}$ and not referred to area
1—Complete train	2.045
2—Complete train with rounded nose (coupe-vent) and a tail piece (fuselage)	1.88
3—Locomotive and tender in presence of the train	1.23
4—Locomotive and tender alone	1.38
5—Locomotive and tender alone with nose-piece	1.31
6—Rear box-car in presence of the train	0.465
7—Rear box-car alone	1.21
8—Rear box-car alone with tail piece	1.095
9—Coach in presence of the train	0.390
10—Coach in presence of the train with tender covered in so as to give it the form of a coach	0.36
11—Coach alone	0.985

These experiments indicate that some improvement can be introduced by only minor modifications. The

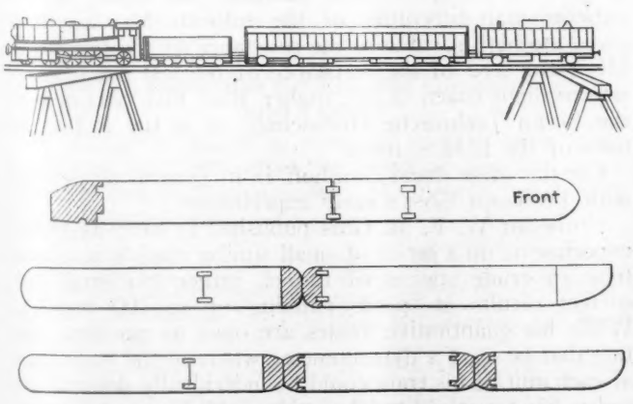


Fig. 11—Maurain's experiments on a French train

effect of the tail piece seems to be more important than that of the rounded nose.

A "fictitious" train as also shown in Fig. 11 was built up smoothly in wood and tested against the actual train. With rounded nose and tail piece $\frac{R}{V^2}$ was reduced to 0.570 giving a reduction of 72.2 per cent. Apparently a high degree of polish improved the resistance considerably.

Another important result of this investigation was the importance of cross-sectional cuts in the model. When in the model "fictitious" train length of 270 centimeters two "cuts" of 2 centimeters each were made the value of $\frac{R}{V^2}$ increased from 0.570 to 0.770 (see Fig. 11). Continuity of surface is seen to be highly important. Sauthoff voices a similar view.

Investigation of an English Ten-Coach Train

Sir Harold Hartley[2] reports some preliminary tests made in a wind tunnel at the National Physical Laboratory, on a 1/40 scale model of an L.M.S. train, comprising a "Royal Scot" locomotive, a tender, and ten coaches. It was found that

29 percent of wind resistance is accounted for by the engine and tender.
8½ per cent by first coach.
6½ per cent by each subsequent coach, or 52 per cent by all intermediate coaches.
9½ per cent by last coach.

The results also showed that at 60 miles an hour, without any head wind, approximately 400 horsepower is absorbed in overcoming the air resistance of such a train. This is said to amount to over 25 per cent of the power developed by the locomotive under these conditions. The air resistance at this speed is then $R = \frac{400 \times 375}{60} = 2{,}500$ lb. Estimating the projected

* Professor in charge, Daniel Guggenheim School of Aeronautics, New York University, New York.

[1] Ch. Maurain, Resistance de l'Air Sur les Trains, Recherches et Invention, November, 1923.

[2] Research on the L. M. S. Railway, The Engineer, June 3, 1932.

area to be 97.5 sq. ft., the following approximate coefficients have been computed:

Part of train	Resistance at 60 m.p.h. in lb.	K on the basis of 97.5 sq. ft. projected area	Per cent of flat plate resistance
Whole train	2,500	.00720	220
Locomotive and tender	725	.00210	64
First coach	212	.00061	187
Intermediate coach	163	.00047	144
Last coach	236	.00068	20.8

Recent German Full Scale Experiments

In 1929 the German "Versuchsabteilung für Lokomotiven im Ausbesserungswerk Grunewald" undertook extensive tests which by extension of the usual methods allow the aerodynamic resistance to be more closely evaluated. These tests have been analyzed by Friedrich Sauthoff,[3] though first reported by Nocon.[4]

The measurements included: 1—Drawbar pull; 2—time.; 3—speeds relative to the track; 4—automatic records of the strength and direction of the relative wind. For these records a recording wind vane, and a Venturi tube connected to a recording pressure gauge were mounted well ahead and above the locomotive.

The true drawbar pull is determined from the equation:

$Pt = Pr + Pg + Pa$ on a straight run at constant track speed where
Pt = total pull
Pr = true draw-bar pull, or train resistance
Pg = pull due to grade
Pa = pull due to acceleration.

For two tests at the same track speed and angle of incidence but different relative winds we can then write

$$R_1 = (A + B\ Vt_1) + K\ (\alpha \text{ constant})\ V^2r_1$$
$$R_2 = (A + B\ Vt_1) + K\ (\alpha \text{ constant})\ V^2r_2$$

$$\text{and } K\ (\alpha \text{ constant}) = \frac{R_1 - R_2}{V^2r_1 - V^2r_2}$$

$$\text{while } (A + B\ Vt_1) = R_1 - K\ (\alpha \text{ constant})\ V^2r_1$$
$$= R_1 - \frac{(R_1 - R_2)}{(V^2r_1 - V^2r_2)} V^2r_1$$

Again if $Rr = (A + B\ Vt)$ = rolling resistance, has been determined at two track speeds,

We can write $Rr_1 = A + B\ Vt_1$
$Rr_2 = A + B\ Vt_2$

$$\text{and } B = \frac{Rr_1 - Rr_2}{Vt_1 - Vt_2}$$

$$\text{while } A = Rr_1 - B\ Vt_1$$
$$= Rr_1 - \left\{ \frac{Rr_1 - Rr_2}{Vt_1 - Vt_1} \right\} Vt_1$$

Obvious methods are pursued in obtaining the acceleration, the mean track speed, the mean relative wind, and the mean incidence angle of the relative wind.

In analyzing results, the assumption is made that the resistance equation of the train is of the form

$$Pr = R = A + B\ Vt + K\ \alpha\ V^2r$$

Where $K\alpha$ = a function of the angle of incidence of the relative wind, α,
Vt = speed on the track
and Vr = speed of relative wind

If then two tests are made with the same track speed, and the same angle of incidence, α, but different relative velocities, then the equation becomes

$$R = (A + B\ Vt) + K\ (\alpha \text{ constant})\ V^2r$$

This is a sufficient outline of the technique employed. The main criticism of this technique is that the drawbar measurements do not give the resistance of the locomotive, and it is the overall resistance of a train including the locomotive which it is essential to determine.

Effect of Train Length on the Resistance Coefficient

The main interest for American readers of Sauthoff's pamphlet lies in his discussion of the effect of train length on the resistance coefficient, and in comparison

[3] Die Bewegungswiderstände der Eisenbahnwagen unter besonderer Berücksichtigung der neureren Versuche der Deutschen Reichsbahn, V.D.I. Verlag, Berlin, 1933.

[4] Nocon, Neue Versuche uber den Fahrwiderstand von Personen und D-Zugwagen Glazers Annalen, March, 1931.

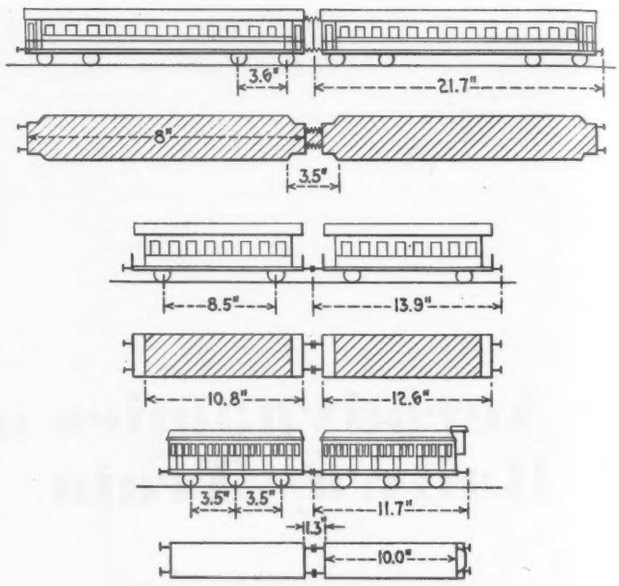


Fig. 12—Outlines of German cars

with tunnel values. He tabulates the equivalent area of (see Fig. 12) various trains (locomotive and tender excluded) as follows:

Train	Equivalent area F in sq. meters	K (on 120 sq. ft. projected area) = .00023 F.
6—car C4 ü	13.1	.00302
10—car C4 ü	19.3	.00445
12—car C4 ü	20.8	.00480
18—car C i	24.0	.00550
21—car C 3	27.7	.00636

From the tests of trains with different numbers of cars, and assuming that intermediate coaches all have the same resistance, Mr. Sauthoff concludes that for the C4 ü cars:

Intermediate car has $F = 1.45$ sq. meters $K = .000345$
Last car has $F = 5.4$ sq. meters $K = .00123$

The value of $K = .000345$ for an intermediate coach is in quite fair agreement with the value of .000397 given by the Berlin Technische Hochschule.

The extra resistance of the last car explains why the resistance of the entire train does not vary proportionately to the length. It is possible that owing to the experimental difficulties of the subject, Mr. Sauthoff gives too high a value to the resistance of the last train. His ratio, 3.82 of the resistance of the last coach to an intermediate coach is far higher than that obtained in the Berlin Technische Hochschule, or at the N.P.L. in tests of the L.M.S. train.

On the other hand Sauthoff is in general agreement with Professor Goss's early experiments.

Professor W. F. M. Goss published as early as 1898[5] experiments on a series of small similar models in a long tube (a crude species of tunnel, rather too small for correct results at speeds running up to 100 m.p.h.). While his quantitative values are open to question, the fact that he used a dynamometer whereby the resistance of each unit of his train could be individually determined makes his experiments interesting. All his models were substantially alike, and Sauthoff derives the following conclusions from an examination of Goss's data, regarding relative magnitudes: Single coach, 12; first coach (electric locomotive), 10; second coach, 0.8; any intermediate coach 1.0, and last coach, 2.6.

It will be remembered that the English experiments gave a ratio of 9½ per cent ÷ 6½ per cent = 1.45 for the resistance of the last coach when divided by the resistance of an intermediate coach.

[5] Electrical Review, Oct., 1898, and The Engineer, 1898, p. 164.

Another interesting derivative of Sauthoff's analysis is illustrated by the following table:

Train	Equivalent frontal area, sq. meters	Length, meters
12 C4 ü	20.8	261
18 C i	24.0	251
21 C3	27.7	246

The shortest train, but with the largest number of cars had the greatest resistance. Long coaches with the smallest number of openings for a given length should therefore give the lowest resistance.

Wind-Tunnel Tests of a Steam Locomotive

In the Canadian National Research Laboratories[6] tests have been made of a C.N.R. 6100 class locomotive and tender by the mirror method on a model of 1/12 scale. A number of systematic modifications were tried out which are reported together with drag measurements in Mr. Green's report. The research was conducted only partly with a view to reduction of air resistance, the main purpose being the improvement of the smoke flow. The following are only the most important selected results from a resistance point of view. The coefficient K is calculated on a projected area of 125 sq. ft. for the full size model:

1—Original unmodified model $K = .00268; \quad \frac{R \times 100}{V^2 \text{ ft./sec.}}$ for model $= .1089$

2—Model with modifications 1-8 $K = .00154; \quad \frac{R \times 100}{V^2 \text{ ft./sec.}} = .0620$

3—Completely modified model $K = .00175; \quad \frac{R \times 100}{V^2} = .0706$

The model with modifications 1-8 gave a very appreciable reduction in the air resistance, but was not considered satisfactory from a smoke point of view. Hence further modifications 9-27 were introduced with a resultant model which gave a somewhat higher resistance coefficient.

Wind-Tunnel Test of a Steam Locomotive in Presence of a Train

Maurain's experiments[7] contain interesting information on the interaction of a locomotive and tender and a following coach. These experiments were made on a 1/20 scale model of a French locomotive, a tender, a passenger car and a box car. The locomotive and tender were tested alone, and then in presence of the entire train. The resistance of the locomotive and tender was reduced 11 per cent by the presence of the train.

Davis's Formulae for Electric Locomotives and Trains[8]

W. J. Davis, Jr., as a result of analysis of a large number of road tests, gives the following formulæ as an appendix to his valuable paper. He includes truck area in his projected area:

	Values of A	K
Locomotives, 50 tons	105 sq. ft.	.0024
Locomotives, 70 tons	110 sq. ft.	.0024
Locomotives, 100 tons and over	120 sq. ft.	.0024
Passenger Cars, vestibuled	120 sq. ft. (leading)	.0024
	100-110 sq. ft. (trailing)	.00034
Multiple-Unit Cars:		
Motor cars, 2 trucks	80-100 sq. ft.	.0024
Motor cars, 1 truck	70-75 sq. ft.	.0024

Comparisons Possible

Even though all possible sources of information have been consulted, a great many gaps and uncertainties exist. Perfectly exact estimates of air resistance are not possible. With the use of judgment reasonable estimates and comparisons can be made.

[6] G. G. Green, The Wind Tunnel Development of a Proposed External Form for Steam Locomotives, Canadian Journal of Research, Vol. 8, January, 1933. See also the *Railway Mechanical Engineer* for May, 1933, page 149, and June, 1933, page 204.

[7] Recherches et Inventions, November 1, 1923. Resistance de l'Air Sur les Trains.

[8] loc. cit.

Comparison of Power for Single Cars

Comparing the coefficients for the parabolic-vestibule car of the St. Louis tests, the test of the conventional rail car, the rectangular box with rounded corners, and the Westinghouse Interurban electric car, we may say that Tietjens' value of K = .00127 is at least reasonable.

Again comparing the values of the streamlined interurban car, the test of the French Midi railway, and of the Jaray car, and inspecting the model of the streamline interurban car, we may say that Tietjens value is a trifle lower than would be realized in practice and assume .0003 as a very good practical value.

At 60 m.p.h. with a projected area of 83 sq. ft. we find

	K	Horsepower to overcome air resistance
Unstreamlined car	.00127	61
Streamlined car	.0003	14.3

The comparison is sufficiently striking.

Table I—Summary of Train Resistance Results

Model	Authority	K	Percentage of flat plate resistance
Single Cars			
Square flat plate	Eiffel	.00327	100
Conventional rail car, smooth sides	New York University School of Aeronautics	.00134	41.0
Jaray streamline car	New York University School of Aeronautics	.000591	18.1
Rectangular box, sharp corners and edges, with wheels	University of Michigan	.002200	67.5
Rectangular box, 9-in. radius corners and edges, with wheels	University of Michigan	.001180	36.2
Ordinary interurban electric car	Westinghouse	.00127	38.8
Perfectly streamlined interurban electric car	Westinghouse	.000204	6.25
Perfectly streamlined interurban electric car for two-way operation	Westinghouse	.000306	9.35
Interurban streamline car, front, rear and roof, but with windows and underparts of the present type	Westinghouse	.000460	14.1
French Midi (best car)	Issy-Les-Monlireaux	.000280	8.5
Short Trains			
Electric locomotive (ordinary)	Westinghouse	.00204	66.5
Electric locomotive (streamlined)	Westinghouse	.00090	26.8
Electric locomotive and one coach (ordinary)	Westinghouse	.00306	93.5
Electric locomotive and one coach (streamlined)	Westinghouse	.00128	39.0
Electric locomotive and two coaches (ordinary)	Westinghouse	.00408	125.0
Electric locomotive and two coaches (streamlined)	Westinghouse	.00164	50.0
German end coach (unstreamlined)	Berlin Technische Hochschule	.000560	17.2
German intermediate coach (unstreamlined)	Berlin Technische Hochschule	.000397	11.8
Union Pacific Train:	New York University		
Model No. 1, cabs No. 1 and 3		.000887	27.2
Model No. 1, cab No. 2		.000963	29.4
Model No. 2		.001038	31.7
Rheinisch-Westfallische Schnellbahn Two-car train with rounded head (lowest value)	Göttingen	.00100	30.6
Long Trains			
6-car C4 u (locomotive not included)	Sauthoff, analysis of full scale results	.00695	212
12-car C4 u (locomotive not included)	Sauthoff, analysis of full scale results	.01020	312
12-car C4 u (locomotive not included)	Sauthoff, analysis of full scale results	.01105	338
Intermediate coach C4 u	Sauthoff, analysis of full scale results	.000345	10.5
Intermediate coach Ci and C3	Sauthoff, analysis of full scale results	.000276	8.2
End coach C4 u	Sauthoff, analysis of full scale results	.00123	36.6
L.M.S. train, locomotive tender and ten coaches	N. P. L.	.00720	220
Locomotive and tender	N. P. L.	.00210	64
First coach	N. P. L.	.00061	18.7
Intermediate coach	N. P. L.	.00047	14.4
Last coach	N. P. L.	.00068	20.8
Locomotives			
C. N. R. locomotive and tender (unmodified)	Canadian National Research Council	.00268	87.5
With modifications 1-8	Canadian National Research Council	.00154	47.0
With modifications 1-27	Canadian National Research Council	.00175	53.5

Comparisons of Power for Trains

The following calculations have been made on a uniform projected area of 125 sq. ft. for air horsepower required at 100 m.p.h. No considerations are offered as regard rolling resistance, passenger accommodation, etc.

Table II—Comparison of Power for Passenger Trains Based on Same Cross-Sectional Area

A = 125 sq. ft. Speed V = 100 m.p.h. $R = K A V^2$ $P = \frac{R V^3}{375}$

Train	Formulae employed	Air resistance in lb.	Hp. required for air resistance
1—Union Pacific train: power car and 2 passenger cars, Model No. 1, Cab No. 1	K = .000887	1110	296
2—Electric locomotive and two passenger cars (unstreamlined)	K = .00408	5100	1360
3—Electric locomotive and two passenger cars (streamlined)	K = .00164	2050	545
4—L.M.S. train, locomotive tender and ten coaches....	K = .00720 cross-sectional area increased to conform to American practice	9000	2400
5—Steam locomotive, six coaches	a. K = .0024+6(.0034) = .004444. (Davis's formula)	5550	1490
	b. K = .00302+.0024 = .0542. (German data)	6770	1810
	c. K = .00507 L.M.S. figures = .00210 + .00061 + 4(.00047) + .00068	6590	1755
6—Electric locomotive and six coaches	K = .00805	10,060	2690
7—French trains:			
a—Locomotive, tender, coach and box car.....	Maurain's estimates..	....	980
b—Locomotive, tender, 10 coaches and box car.	Maurain's estimates..	....	2440

Railroad men will be able to make such calculations for themselves far better than the writer of this article. The results are summarized in Table II, to which the following comments apply:

Line 1—The value of K is taken directly from tunnel test without correction.

Lines 2 and 3—The Westinghouse tunnel results for the streamlined train are taken without correction.

Line 4—The assumption has been made that only a correction for cross-sectional area need be applied. This is not strictly correct; the resistance of an American train would be somewhat greater owing to its greater length and skin friction.

Line 5—A number of calculations based on different assumptions have been made here. The first calculation has been made on Davis's formulæ where K = .0024 for the locomotive and .00034 for coaches. The value of K for the locomotive given by Davis is less than that determined from the Ottawa tests, but the C.N.R. locomotive was not faired in by a trailing car. The second calculation has been made on the basis of the German six-car C4ü train, with an addition of .0024 for the locomotive. The third calculation has been made by taking the coefficients of the L.M.S. train for the ten-coach train and applying them to a six coach train.

Line 6—The Westinghouse tests were made on an electric locomotive and two coaches. By linear extrapolation to a six-coach train, Dr. Tietjens arrived at a value of K = .00805. Tietjens' coefficient for the electric locomotive is a trifle below Davis's figure but his value for a coach of .00102 is nearly three times as high. It would seem that extrapolation is dangerous, until a fair number of coaches have been included.

Line 7—Maurain's estimates are based on a tunnel test of a locomotive, tender, coach and box car, with extrapolation to ten coaches for French construction and are reproduced without correction.

Conclusions

In view of the fact that tests have been in different tunnels and by different methods, *all the above comparisons and calculations should only be regarded as approximate.* The following conclusions may be drawn however:

1—The ordinary steam locomotive and tender is highly wasteful from the point of air resistance, more so than the electric locomotive.

2—The air resistance of an ordinary steam locomotive can be appreciably reduced by fairing without any basic change in its design.

3—The first coach of a steam train is badly affected by the low height of the tender preceding it.

4—Extrapolation from tests of very short trains to long trains is unjustified, because the resistance of intermediate coaches in a long train is relatively so low.

5—Considerable improvement may be expected by such modification of conventional train equipment as: addition of a nose piece; addition of a tailpiece; covering in of tender; "smoothing out" of sides of train; care in design of intercommunicating corridors. Sum total of such changes may be surprisingly effective.

6—Rounding of corners is helpful.

7—Truck and wheel resistance is an appreciable proportion of the entire resistance of a coach.

8—Modern equipment such as the Union Pacific Train should have only a fraction of the resistance of even a short conventional train.

9—Exact computations of air resistance for steam trains are impossible on present data.

10—Rail cars, trolley cars and very short electric cars may have their resistance reduced appreciably by very simple methods.

A study of the effect of side winds has been made and the general conclusion is that a streamlined train will, even in side winds, show aerodynamic superiority over the conventional train. Some reservations have to accompany this statement in the present state of our knowledge. The effect of side winds will be adequately discussed in an article to be published at a later date.

* * *

Convenient storage rack which helps to keep material off the floor in the car shop—Illustration shows bottom rods, turnbuckles, levers, reservoir blocks and bands, hand-brake chains, etc.—A shelf is provided on the wall at the left for dope buckets and oil cans

All-Welded Light-Weight C. M. St. P. & P. Coach

Interesting design of welded construction effects marked weight reduction — Unusual provision made for passenger comfort

THE Chicago, Milwaukee, St. Paul & Pacific now has constructed at its Milwaukee shops the first six units of an order of 52 streamlined, light-weight, all-welded steel coaches which are a distinct departure from ordinary car-building practice and which provide comforts, and indeed luxuries, not ordinarily available in coach equipment. With a saving of about 35 per cent in weight over conventional coaches of the same size, the new cars are designed to effect substantial economies in operating cost and also to facilitate maintaining higher train speeds.

All-Welded Body Construction

The new coach, No. 4400, is of conventional size, being 10 ft. wide by 13 ft. high above the rails and 72 ft. 6 in. long over the body end posts, or 80 ft. 8 in. long over the pulling faces of the couplers. It weighs about 96,000 lb. and has a total seating capacity of 54, including 40 in the main compartment, five in the ladies' lounge room and nine in the men's smoking room. This may be compared with a total weight of 146,000 lb. and a total seating capacity of 78 in conventional Milwaukee coaches of the same size, embodying riveted steel construction.

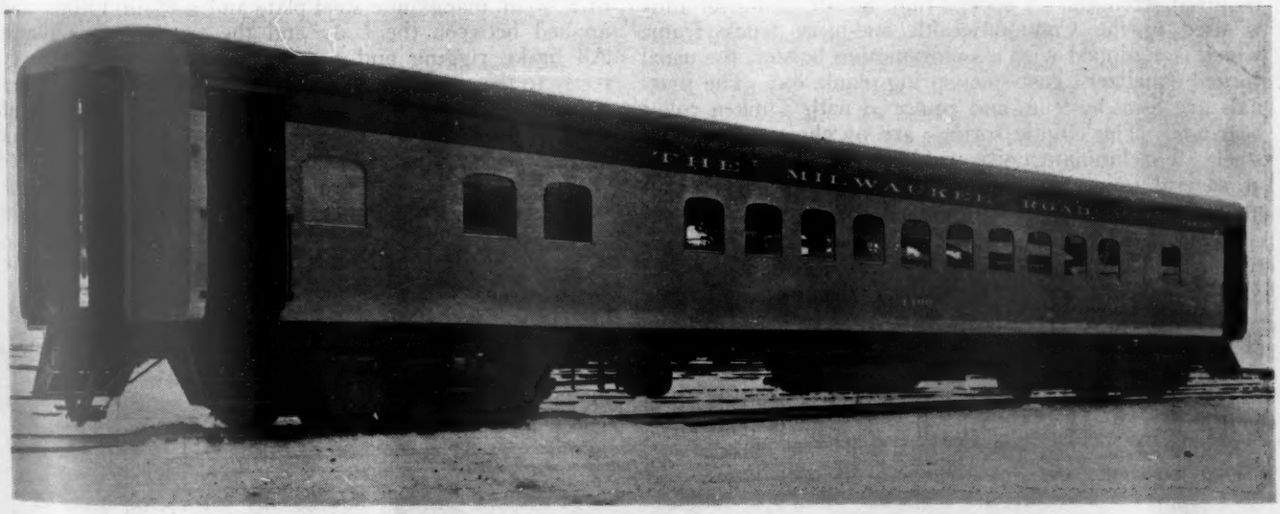
The new car is tubular in shape and streamlined to the extent that it has a turtle-back roof, side sheets rounded inwardly below the windows and no projections on roof or sides such as ventilators, window sills, belt rail, etc. The entire body of the car is fabricated by electric welding and without the use of rivets. The underframe, including the center sill, bolsters, buffer beams and body end sills, is a built-up design, consisting of structural shapes, plates and sheets joined by welding. The floor pans are made of ⅛-in. sheets, formed with the flanges extending from side sill to side sill. These pressed pans are joined to each other and to the car frame by continuous and, in some places, staggered welds, the latter overlapping. The top floor is made of 1¼-in., 5-ply, pine veneer secured to the pan flanges by Parker-Kalon self-tapping screws. The body and vestibule end frame construction is built up of steel shapes, pressings and sheets, also joined by welding. The side sills consist of 4-in., 8.2-lb. Z-sections, extending from body corner post to body corner post. Subsequent cars will include Commonwealth one-piece cast steel bolsters and platforms.

The side pans, all of ⅛-in. steel sheets, are of three different sizes, the first extending between the windows from the side sill to the side plate and made with channel-shaped flanges. The second pan extends from each window down to the side sill, the top flange of the pan forming the window sill. The third pan extends from the top of the window to the side plate, with angle-shaped flanges on four sides. The pressings are made with open corners and have holes punched in the flanges for the purpose of firmly bolting them together and squaring the entire superstructure before welding is started. After the superstructure is welded, which includes closing up all the open corners, the bolts are removed. All flanges are continuously welded both inside and out. The window frames, oval at the top and square at the bottom, are of No. 12 gage steel, pressed to a U-shaped contour, with inwardly projecting flanges to suit the window construction.

The turtle-back roof is formed of 3/16-in. pressed side plates and 1/16-in. roof sheets which are pressed-steel pans flanged on all sides, with open corners subsequently filled in when the flanges are welded. The ridge pole comprises ⅛-in. by 3-in. steel strips welded between the center-pan flanges.

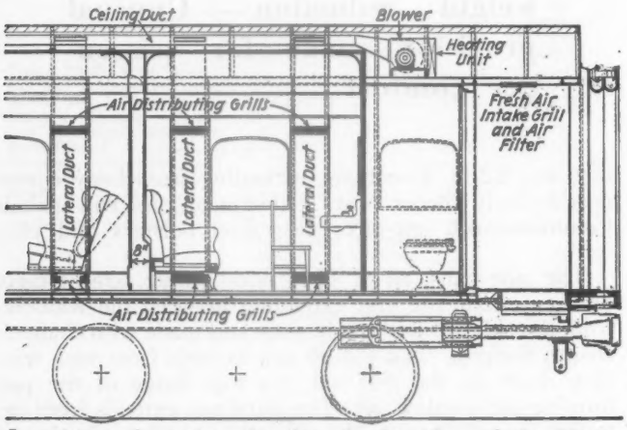
Aluminum-Foil Insulation

The car is completely insulated with a new type of



New Milwaukee light-weight, all-welded steel passenger coach

aluminum-foil insulation notable for light-weight and low heat conductivity. This material, known as Reynolds' Metallation is furnished by the Reynolds Metal Company and consists of thin aluminum foil, of about .0005 in. gage, firmly cemented to one or both sides of a tough, heavy craft paper and applied in a series of layers with ½-in. to ¾-in. air spaces between the respective layers. Insulation pads, comprising three double layers and two single layers of this material, are held in fabricated frames made from wood or other



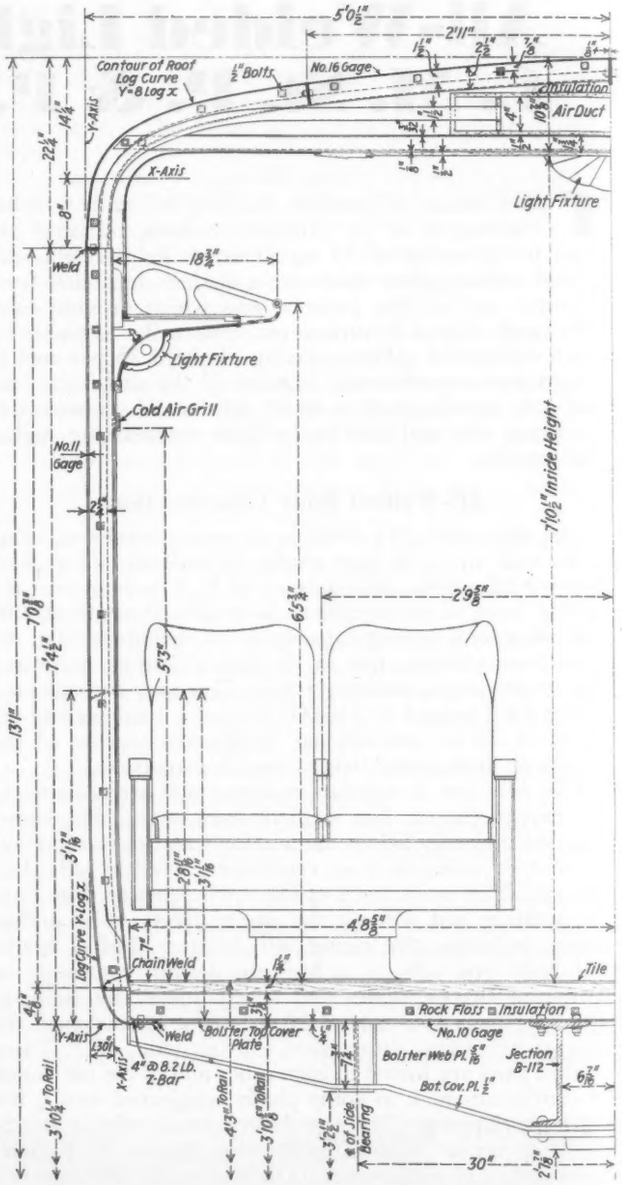
Longitudinal section showing the location of the blower fan and the air-distributing ducts

material, which fit in the floor and side pans. At curved sections in the car body, such as the lower side and the roof, K-B board, or flexible linoleum, is fitted in the curved pans, and the paper-backed aluminum foil held in place against the linoleum by Gagnier metal clips, such as are used in the automotive industry for applying panels of interior finish.

A further adaptation of automotive practice is followed in the application of Insulmat, a sound-deadening material which is sprayed to a thickness of about ⅛ in. on all interior wall metal surfaces to dampen vibration and reduce the transmission of external noises to the interior of the car. A single layer of craft paper with aluminum foil on one side is then applied directly on this sound-deadening material.

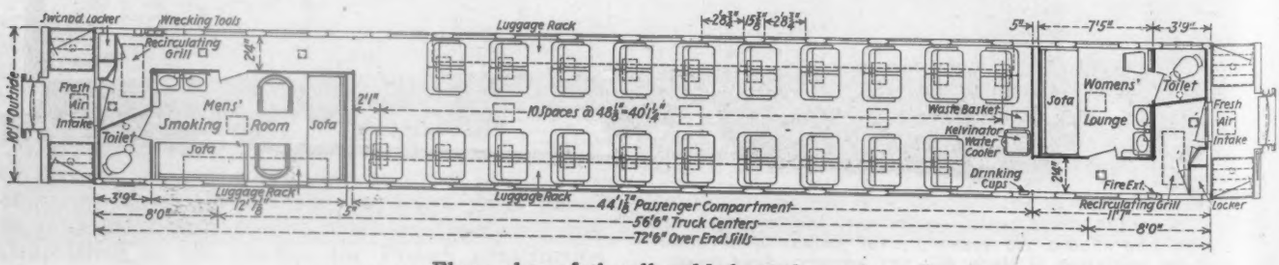
The Trucks

The four-wheel truck design was developed with a view of obtaining minimum weight consistent with the required strength. A special high-tensile cast-steel alloy is used in the Commonwealth one-piece truck frame which is equipped with a swing-motion bolster, the usual forged equalizers, cast-steel spring plank, etc. The journals are 5-in. by 9 in. and equipped with Timken roller bearings. The elliptic springs are of chrome-vanadium steel. To eliminate noise, rubber inserts are employed at several points in the truck construction to prevent metal parts subject to vibration from coming in direct



Half cross-section of Milwaukee all-welded coach

contact. Ease of truck swiveling is assured by the use of a ⅛-in. manganese steel plate and a ¼-in. Oilite plate applied between the body and the truck center plates. All brake rigging and connected parts are applied directly to the truck which is equipped with American Steel Foundries Simplex unit-cylinder-type clasp brakes, with one 8-in. by 7-in. brake cylinder mounted on each side of the truck frame. One of the trucks is also equipped with the Dayton-Roderwald combined V-belt and universal type axle-generator drive. The truck with the



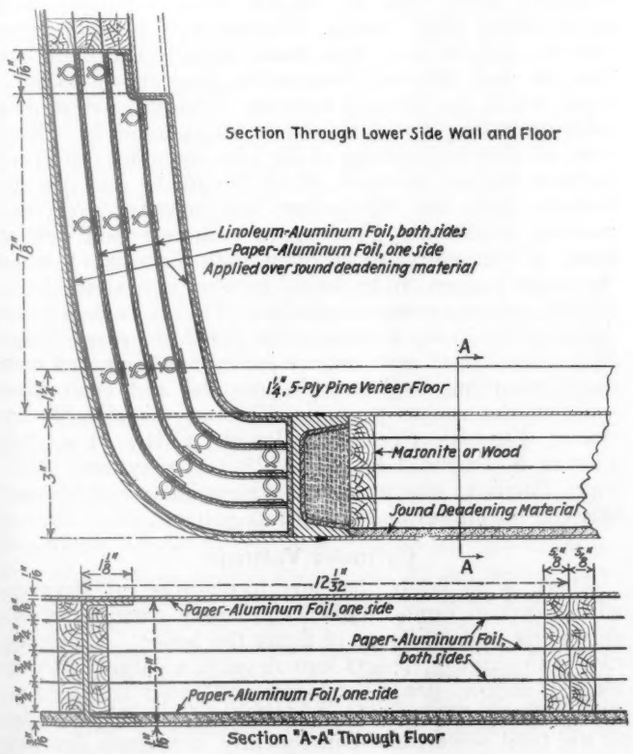
Floor plan of the all-welded steel coach

generator drive weighs 15,310 lb. and the plain truck, 14,560 lb.

Heating, Ventilation and Lighting

The car is heated and ventilated by means of a system of concealed air ducts, steam pipes, motors and blowers, the system being designed with a view of ultimately applying air-conditioning apparatus. A Sirocco blower unit rated at 1,000 cu. ft. per min. is located under the roof in each end of the car, forcing air through the Vapor copper-tube and fin-type heating and cooling unit, as the case may be, and into a central ceiling duct, from which it is distributed into lateral ducts located behind the pilasters at each seat and finally into the car through Uni-Flow grilles. There are two grilles in each pilaster and, during the winter season, the top grille is closed by means of a damper, thus forcing the hot air to pass to the lower grille at each seat base near the car floor. For summer cooling the damper in the upper grille is opened, thus automatically blocking the passage to the lower grille and permitting the cool air to pass into the upper section of the car.

The blowers are of the double-intake type, fresh air being drawn through an air filter and grille located in the ceiling of the vestibule, with a suitable damper arrangement provided to control the proportion of fresh air admitted. Recirculated air is drawn through a second grille in the ceiling of the hall adjacent to the end door. Temperatures in the car are kept within desired limits



Sections showing the application of aluminum insulation at lower side wall and floor

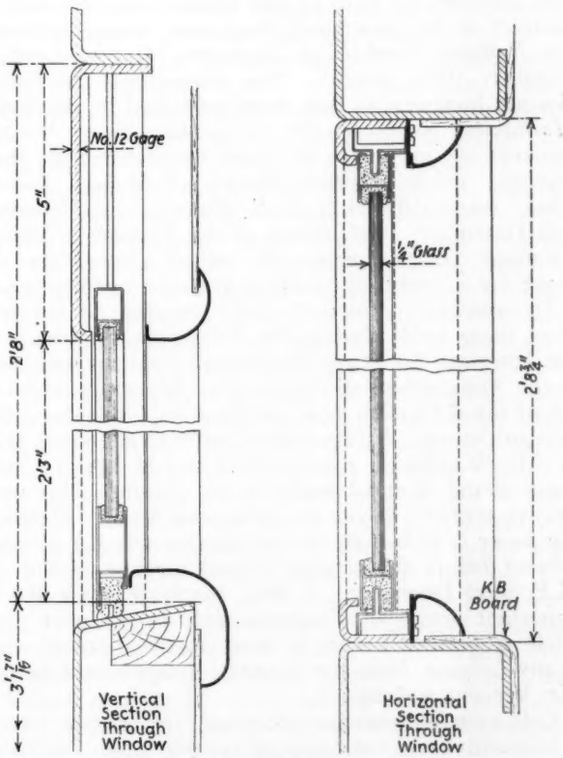
by means of Vapor thermostat control equipment. For emergency or yard heating, heating coils are provided in the partitions between the main body of the car and the lounge rooms, these coils being of sufficient size to heat the air in the car to around 50 or 60 deg. in sub-zero weather.

Electric power for the 32-volt lighting system in the car is provided by means of a Safety 5-kw. generator driven by a Dayton-Roderwald V-belt unit mounted on one of the trucks. This generator furnishes power for the lights and for charging an Exide Ironclad 450-amp.-hr. storage battery, as well as supplying power for blower motors, water cooler, etc.

The lighting system is designed to give a light intensity at the reading level of about 8 foot-candles. The ceiling lights are supplemented by individual bracket lights under the luggage rack adjacent to each seat which gives a uniform distribution and avoids shadows. All lighting fixtures are of a unique and attractive design in aluminum.

Interior Finish and Conveniences

Unusual attention has been given to the interior finish, the layout and the provision of exceptional comforts. A glance at the floor plan shows the ample size of the men's



Sections through the windows

smoking room and the women's lounge. Seats in the main room are of the high-back, double-rotating, adjustable, reclining type spaced 48½ in. on centers, with the center line of the base opposite the panel section between the windows. Windows are of ¼-in. polished plate glass, frameless and moved up and down in felt-covered rubber guides by Briggs & Stratton regulators. Overhead baggage racks are continuous and spacious. The interior finish is composed of removable cloth-covered panels; the floors are of Durite asphalt tile in colors, harmonizing with the upholstery and tapestry color effects of the interior finish. The ceiling is of five-ply poplar veneer, flat at the center with curved sides and ends. The general color scheme is a light flesh colored ceiling, brown side walls and green floors, with aluminum trimmings and lighting fixtures.

Another provision for the comfort of passengers is the installation of a Kelvinator electric water-cooling cabinet especially designed for railroad service. Dixie individual paper cups are provided.

Tractive Force of Steam Locomotives

By A. I. Lipetz*

Discussion of the Comments Made by H. S. Vincent to an A.S.M.E. Paper by A.I. Lipetz on the Ratios of Modern Locomotives

AT the annual meeting of the American Society of Mechanical Engineers, December 5 to 9, 1932, I presented a paper on "Horsepower and Tractive Effort of Steam Locomotives (Locomotive Ratios)" which was published in the Railroad Section of the Transactions of the Society for July 30, 1933, under RR-55-2. The Transactions also contained the remarks of 16 discussors (pages 16-32) and the author's closure (pages 32-42).

H. S. Vincent participated in the discussion and presented valuable and original remarks pertaining to a method of figuring tractive efforts developed by him. To this an essential part of my closure was devoted. An abstract of the paper and discussions were published in the *Railway Mechanical Engineer* (March, April and October, 1933, issues). The discussions and author's closure, however, as they were published in the *Railway Mechanical Engineer,* did not contain either Vincent's remarks or my reply to them for the reason that a separate article, entitled "Ratios of Modern Locomotives," was published by H. S. Vincent in the November and December, 1933, issues of the *Railway Mechanical Engineer*. Consequently, the editor allotted me some space for a reply, of which I am now availing myself.

In substance, Vincent's later remarks do not differ from those made during the discussion of my paper in the American Society of Mechanical Engineers as printed in the Transactions of the Society. My reply which followed his discussion was not taken by him into account in many cases. To attempt to reply to all points raised by Mr. Vincent in his article, I would have to repeat some of the remarks made in my closure. This would involve fruitless debate on immaterial details. Moreover, my paper is to be followed by another which I expect to present before the coming annual meeting of the A.S.M.E. next December. I shall, therefore, leave the less important details of Vincent's reply to my next paper, while at present I want to reply to those points which, in my opinion, form the essential disagreement between Mr. Vincent and myself.

Cole's method permits to evaluate the tractive force of a locomotive on the basis of cylinder sizes, while the method suggested by me does the same thing on the basis of boiler evaporation. In either case certain constants are used, called "speed factors" in Cole's method, and "moduli" in my method. Vincent, on the other hand, prefers a formula, which is an empirical one containing both cylinder sizes and boiler evaporation.

On the basis of six locomotives, of which five were long cut-off locomotives and one a limited cut-off locomotive, I showed that the tractive force can be simply represented by the boiler evaporation and certain moduli. Vincent, using five examples of locomotives, of which three are limited cut-off and two are long cut-off locomotives, tends to show that my moduli do not agree with test figures. He also shows that for two long cut-off locomotives tested at the Altoona testing plant his formula is in agreement with test results, but it follows from his curves that my moduli give equally good agreement with tests for these two cases. The fact, however, that the tractive force of one limited cut-off locomotive, namely, the Boston & Albany A-1, can be well represented by my moduli, is set aside with the questioning of the validity of that particular test. The fact of the agreement in the case of the A-1 locomotive will be explained later. Further, Vincent does not give any explanation of the fact that, as shown in my discussion (page 34), his formula gives exaggerated results when compared with road test figures.

It is true that my method has been based on road test figures. It is further true that Vincent's formula corresponds better than my moduli when compared with some testing plant results. Furthermore, it is also true that my figures have been based mainly, except in one case, on data obtained from testing long cut-off locomotives, while the Vincent formula is based on test data from both long and limited cut-off locomotives. However, all this has nothing to do with the main difference between the two methods, which lies in the fact that his formula gives too high values for ordinary every-day running conditions. They agree with test data (either road, or stationary, more often with stationary) when the boiler happens to be forced to what is near the limit, but not under average conditions. This is evident from curves given in my closure to the A.S.M.E. paper (page 34), where actual performance curves are compared with those according to Vincent's formula, and even from some of the curves given in Vincent's article, for instance, Fig. 8[1] (Texas & Pacific G-1b), Fig. 11[2] (Texas & Pacific I-1), Fig. 12[2] (three-cylinder Missouri Pacific), where a great discrepancy can be seen between his curves and actual test points.

Cylinder Volume

There is no doubt that any locomotive can develop, within certain limits, higher and lower tractive forces, depending upon the rate of firing the boiler. A locomotive with large cylinders can develop a larger tractive force, if at low speeds the locomotive boiler is forced at these speeds. This can be done the easier at low speeds, as the total power, and consequently, the steam demand on the boiler, is then usually low. It is immaterial whether the locomotive is of the limited cut-off or of the long cut-off type. The large tractive force is only a result of the large size of cylinders and boiler firing.

Mr. Vincent was very close to the proper explanation of this fact when he made up his Table I, Design Ratios.[3] He gave in the last column the ratios of evaporative heating surface in square feet to the volume of two cylinders in cubic feet. He stated that this ratio,

* Consulting engineer, American Locomotive Co., Schenectady, N. Y. Non-Resident Professor, Purdue University, Lafayette, Ind.

[1] *Railway Mechanical Engineer*, November, 1933, page 394.
[2] *Railway Mechanical Engineer*, December, 1933, pages 430, 431.
[3] *Railway Mechanical Engineer*, November, 1933, page 390.

according to a recommendation of the American Railway Master Mechanics' Association made in 1897, was to be 200, and that for modern locomotives it varies from 217.5 to 247.5.

This ratio is very important, and in order to be more significant, it should also include boiler pressure. It is evident that two locomotives identical in all parts, one having a boiler pressure of 200 and the other a boiler pressure of 300 lb. per sq. in., can not have identical cylinders, even if both locomotives have the same, either long, or limited, cut-off. The cylinders for higher boiler pressure must, of course, be proportionately smaller, and, therefore, boiler pressure must be taken into account when cylinder sizes are being considered. In accompanying Table I, column 2, all locomotives used by Vincent in his article and by me in my paper are shown. Other data are given in the next columns: In column 3—heating surfaces in square feet (H_e); in column 4—boiler pressures in pounds per square inch (p_b); in column 5—volumes of all single-expansion cylinders in cubic feet (U), and in column 6—the ratio of figures of column 3 to the product of the figures of columns 4 and 5, in other words, the heating surface referred to the boiler pressure and cylinder volume, or $m = \frac{H_e}{p_b U}$

Table I

1	2	3 H_e sq. ft.	4 p_b lb. per sq. in.	5 U cyl. vol. cu. ft.	6 H_e / $p_b U$ $m = p_b U$
I	New York Central J-1	4484	225	15.90	1.253
	Pennsylvania E6s	2688	205	11.44	1.146
	Lehigh Valley 5100	5422	250	19.88	1.091
	Lehigh Valley 5200	5441	255	19.66	1.085
	Pennsylvania K4s	4035	205	18.56	1.061
	Timken 1111	5111	250	19.88	1.028
	New York Central L-2	4449	225	19.88	.995
	Boston & Albany A-1	5110	240	21.40	.995
II	Missouri Pacific 3-cyl.	3786	200	22.03	.859
	Texas & Pacific I-1	5113	250	24.46	.836
	Texas & Pacific G-1b	3811	200	22.81	.835
	A., T. & S. F. 5000	6135	300	27.82	.735
	Pennsylvania Ils	4774	250	27.06	.706

It is interesting to note that notwithstanding the wide variation in columns 3, 4 and 5, column 6 is more steady, both for group I, which includes all long cut-off locomotives and the B. & A. A-1, which is a limited cut-off locomotive, and for group II, which includes limited cut-off locomotives as well as the Mo. Pac. three-cylinder and the T. & P. G-1b, long cut-off locomotives.

The common feature for locomotives of group I is that my moduli do agree with test results for these locomotives, whether long cut-off or limited cut-off locomotive, while the common feature for the locomotives of group II is that my moduli do not agree, irrespective of whether they are of the limited or long cut-off type. At the same time the common feature of the first group of locomotives is that the ratio m is above .995, or, roughly speaking, 1.0, while this ratio for the second group of locomotives is below .859, or, say, .86, there being a wide gap between the coefficient m of these two groups.

The fact that the coefficient m for the first group is 1.0 or more, and for the second group it is .86 or less, simply means that the cylinders of the first group are normal while the cylinders of the second group are excessive, and Vincent's criticisms of my moduli are thus reduced to the fact that my moduli do apply to locomotives with ratio m of .995, approximately 1.0, and more, while they do not apply to locomotives with m equal to .86 or less, in other words, to locomotives with over-sized cylinders.

The above also explains why the test results of the B. & A. A-1 locomotive ($m = .995$), although of the limited cut-off type, are in agreement with my moduli and, therefore, it is not surprising at all to see that this locomotive gives results in accordance with my moduli; there is no necessity for questioning the test report.

"Tractive Force" Needs Explanation

As explained in my paper and in the author's closure, the term "indicated tractive force" becomes a definite conception only when the conditions at which the tractive force is produced are specified, as for instance, the *maximum* tractive force, the *most economical* tractive force, the *constant evaporation* tractive force, or constant *coal rate* tractive force. (Transactions RR-55-2 of the A.S.M.E., page 40). If we were concerned with the maximum tractive force, this conception would be definite, and this is what the majority of the Altoona test results is giving. Vincent is not trying to produce the maximum tractive force because he states that "this (maximum) is always greater than the normal tractive force," which is "in accordance with the best known practice for its type and in which the fuel consumption and evaporation reaches but does not exceed a predetermined limit.[4] This is exactly what I call in my paper "performance tractive force," and which is represented by my moduli. According to Vincent, it is less than the maximum tractive force and, therefore, there should be no surprise that my curves are lower than the Altoona test curves. Professor Lomonossoff made extensive and accurate tests, among others, with 0-10-0 locomotives, both on the road and on a stationary testing plant, and found that the former gave in some cases up to 23 per cent lower results than the latter, the locomotives in both cases being identical in all essential details.[5]

Neither of the foregoing clearly defined tractive forces should actually be considered in our problem because during operation the locomotive is burning no constant amount of coal per unit of grate area per hour; nor is it generating a constant amount of steam per unit of heating surface per hour; nor does it work at constant efficiency, or any other condition to which we might wish to limit ourselves for the simplicity of our analysis. The fact is that the operation of the locomotive is being conducted so as not to exceed certain excessive straining which would cause damage to the tubes, clinkering, drop in superheat or pressure, etc. It consists mainly of this best known practice, according to Mr. Vincent, of operation of a locomotive, about which an experienced engine driver knows how, but probably would not be able to explain why, and which ultimately results in a more economical operation as regards fuel, maintenance, etc. It is always possible to force the boiler and get more power from the locomotive up to a certain limit, and there is no doubt that it is, therefore, possible during tests to get tractive forces that are higher than obtained, from regular service runs, called performance curves. My study of these problems showed that these curves are better understood from the point of view of overall locomotive efficiency. I have chosen the Pennsylvania Ils locomotive No. 4358 for this analysis for the reason that the discrepancy between my moduli and the Vincent formula is more pronounced in this locomotive than in other any other of those referred to by Mr. Vincent. The Ils is the best example of an over-cylindered locomotive, m being only .706, the lowest in Table I.

Overall Efficiency an Important Factor

Fig. 1 shows tractive-force curves of the locomotive. The Vincent curve is shown in a dash-and-three-dot

[4] *Railway Mechanical Engineer*, November, 1933, Page 391.
[5] 0-10-0 Locomotives E, Esh, Es, by G. Lomonossoff, Berlin, 1924 (in Russian), page 201.

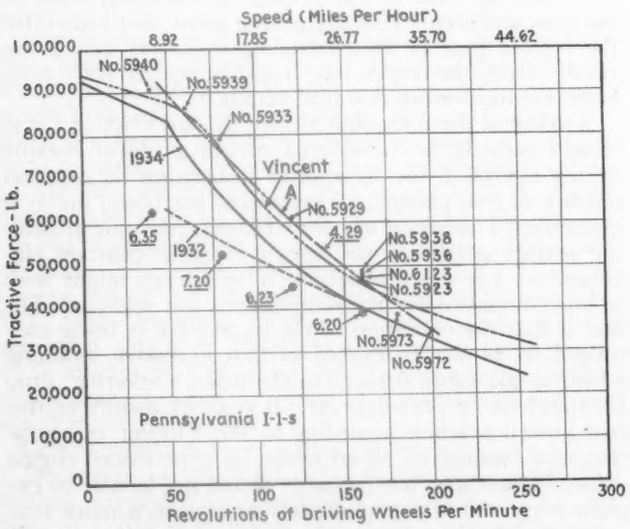
line.[6] The maximum test figures are shown by points with numbers corresponding to test numbers given in Pennsylvania Railroad Bulletin No. 32. A dash-and-one-dot line (curve A) is the one that approximates the test figures best. It is really very close to the Vincent curve. In Fig. 3 of his article Vincent marked also points from another I1s locomotive (No. 790) which I omitted in the present chart because this locomotive has a different boiler, a type A (instead of E) superheater, and has no feedwater heater.

In my closure to the discussion of the paper I enumerated in Table 19 (page 36) the main data of these high tests. They are partly repeated in Table II herewith, which includes all the high points of curve A.

Table II

Test number	Boiler efficiency, per cent	Overall locomotive efficiency, per cent
5940	56	4.7
5939	55	5.1
5933	54	5.6
5929	42	4.0
5938	41	3.6
5936	39	3.8
6123	36	4.1
5923	45	4.5
5972	49	4.4
5973	35	3.1
Average	45.2	4.29

This shows that the overall efficiency fluctuated between 3.1 and 5.6 per cent. The average of these overall



Revised tractive force curve

efficiencies is 4.29, marked on curve A. The average boiler efficiency for the maximum tests was only 45.2 per cent. In other words, the boiler and the locomotive were highly stressed, and then they gave a tractive-force curve that coincided with the Vincent formula.

All other test figures given in the test report are below this and the Vincent curve. The averages of the tractive forces of all tests for each of the speeds at which the locomotive was tested (40, 80, 120 and 160 r.p.m.) are marked on the chart by points in circles. The averages of corresponding efficiencies are shown by underlined figures. They vary between 6.20 and 7.20 per cent. It is interesting to note that the points which correspond to the averages, shown on the chart by points in circles, come very close to the curve on the basis of my moduli (1932); in other words, while it may be true that it is possible to get for this locomotive as large a tractive force as represented by Vincent's formula, the overall efficiency of such a locomotive performance would be only 4.29 per cent, whereas, if the operation is performed in accordance with the 1932 curve, the efficiency of such a performance would be about 6 per cent.

This is true with respect to the performance of other locomotives in accordance with my moduli, which means that they correspond to a reasonable, economical utilization of a locomotive, although it may be also true that tractive force of 10 to 15 per cent more can be obtained, if the operator is satisfied with a much lower overall efficiency. He will gain some in tractive force, but lose much in economy.

Revised Curves for Large-Sized Cylinders

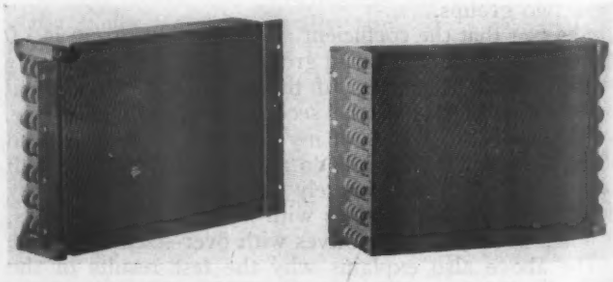
I must concede, though, that for locomotives with large-size cylinders it may be necessary to force the boiler at low speeds in order to approximate the starting or adhesion tractive force. I have, therefore, devised a new method for locomotives with ratio m less than 1.0. By this method it is possible to modify the shape of the curve between 50 and 150 r.p.m. as shown approximately on the chart in full line marked 1934. The manner of plotting this curve, depending upon the above mentioned coefficient m, will be expounded in the coming paper before the A.S.M.E., next December. This curve comes up closer to the maximum test figures for low speeds than the 1932 curve, corresponding to a lower overall efficiency, probably of 5 per cent, and following later the 1932 curve with about 6 per cent overall efficiency. The essential difference between the 1932-1934 curves and the Vincent curve lies in the difference of the just mentioned overall efficiencies (6, 5 and 4 per cent, approximately).

[6] Copied from Fig. 3 of Vincent's article, *Railway Mechanical Engineer* November, 1933, page 391.

Heat Transfer Surfaces For Air Conditioning

THE Young Radiator Company, Racine, Wis., after having had a broad experience in the development of heat-transfer surfaces for commercial and other purposes, has recently assisted leading manufacturers of rail equipment in the development of suitable heat transfer surfaces for air-conditioning apparatus. Special evaporators and condensers of sturdy construction, built to withstand rail vibration—the severest kind of service—have been improved to a high degree.

The accompanying illustration shows two views of a Young condenser. The tubes and fins are fusion bonded, made integral for strength and to provide the best possible heat conduction. The entire surface is copper, but, for special installations where weight is a governing factor, aluminum cores have been developed and are working satisfactorily.



Young 4-row fusion bonded fin condenser coil—Connections adapted for Freon

EDITORIALS

A Trend in Locomotive Development

It is probable that the German State Railways have had more experience in the operation of steam locomotives which depart radically from the time-honored type both as to boiler construction and in the method of converting the energy in the steam into useful mechanical work than have the railways in any other country. This experience has included turbine locomotives, high-pressure locomotives, and locomotives burning pulverized coal. Excepting the pulverized-coal locomotive, which included the conventional boiler, these developments all concentrated on improving the thermal efficiency. Parallel with these experimental developments has been a sustained development of standard locomotives of conventional type with a view to producing a locomotive of good operating characteristics rather than one of unusual heat economy.

It is, therefore, significant that the trend in thought with respect to locomotive development in Germany now appears to be swinging in the direction of intensive development of standard types of locomotives rather than the development of experimental types necessary for the high pressures and temperatures on which major improvements in thermal efficiency depend. Prof. H. Nordmann in a recent article in the Zeitschrift des Vereines deutscher Ingenieure, reviewing a series of tests to determine the performance of the most modern standard locomotives and how far an increase in thermal efficiency can be carried within the limits of pressure and temperature associated today with the standard type of boiler construction, points out that the cost of fuel amounts to only about 21 per cent of the total cost, including capital charges, repairs and wages. A further consideration which has detracted from the prospects of experimental types of locomotives has been the relatively low availability and the fact that engine failures are particularly undesirable at the present time in view of the keen competition offered by other means of transportation. For these reasons the author states that the attractiveness of radically new types of locomotives has decreased materially and, while such developments will not be discontinued completely, they have little chance to progress at the present time.

First cost and maintenance are items of such importance in determining the ultimate economic value of a locomotive that improvements in thermal efficiency and, hence, fuel economy, which effect major increases either in first cost or the cost of repairs, are looked at askance by railway men in America as well as in Germany. In the first place, there is the uncertainty as to whether a certain improvement in thermal efficiency will result in a corresponding increase in fuel economy under every-day operating conditions. Again, there is the uncertainty as to what maintenance costs will prove to be. Probably one of the strongest factors in causing hesitation to deal with locomotives in which radical departures have been made from conventional types of construction is the uncertainty as to reliability which is of no less importance in America than in Germany.

The changes which have been introduced in locomotive construction in recent years have been aimed as much, if not more, at effecting reductions in maintenance and increases in reliability as at improvements in thermal efficiency. American experience, indeed, has proved that practical fuel economy depends in as large measure on proper supervision of the selection, handling and firing of coal as on the thermal efficiency of the locomotive itself. As the result of the intensive campaign for fuel economy during the past twenty years the cost of fuel has become a relatively less important factor in the total cost of locomotive operation than has the cost of repairs. The present situation, therefore, would seem to call for concentrated attention on reducing the cost of repairs. This involves the design of locomotives, but it also calls for attention to organization, methods and facilities for economical repair processes as well.

Mechanical Conventions In 1935

In the July number of the *Railway Mechanical Engineer* we published an interview with a railway executive, in which he stressed strongly the advisability of reviving the work of the various mechanical associations and scheduling conventions for 1935. The last full membership convention of the Mechanical Division of the American Railway Association was held at Atlantic City in 1930; since that time the General Committee has met each year to receive reports from the various committees and transact necessary business. Several of the other mechanical associations have held no meetings during the past four years. During that time there have been many changes in personnel and it promises to be a difficult task to build up the membership and revive the work of the associations to such an extent that they will adequately meet the challenge of changed conditions and new requirements.

The interview in the July number stirred up a considerable amount of discussion and since that time the import of the comments received has been reflected in editorials in each issue of the *Railway Mechanical En-*

gineer. The General Committee of the Mechanical Division, at its meeting in Chicago in June, decided to hold a full membership meeting of the Mechanical Division next year. On September 17 and 18, the International Railway Fuel Association and the International Railway General Foremen's Association held short meetings in Chicago. On September 18 representatives of the various mechanical associations, other than the Mechanical Division, A.R.A., met at Chicago and decided to hold full membership meetings early next May, with a common exhibit of railway equipment and supplies.

Four of the associations, the Traveling Engineers, Air Brake, International Railway General Foremen and Car Department Officers, will hold individual, but simultaneous meetings on Thursday, Friday and Saturday, May 2-4. Four other associations, the International Railway Fuel, Master Boiler Makers, American Railway Tool Foremen and International Railway Master Blacksmiths, will meet on Monday, Tuesday and Wednesday of the following week. It was decided to hold these meetings in Chicago, with an exhibit under the direction of the Allied Railway Supply Association. The conventions are scheduled for early May, since that comes between seasons, at a time when the men can best be spared for the meetings. The central location will make it possible for a large number of members to attend the meetings with a minimum loss of time from their roads.

The assumption apparently has been that the Mechanical and Purchases and Stores divisions of the American Railway Association will hold meetings at Atlantic City in June, with an exhibit. Expressions from railway supply people rather question the desirability of putting on an exhibit if only a short meeting is to be held. There is a pronounced sentiment, also, that it might be better to hold the Mechanical Division meeting and the conventions of the other mechanical associations at the same place, so that one exhibit will suffice for all the conventions.

A number of railway supply men rather question the advisability of putting on an exhibit at a resort city, the feeling apparently being that it would cost less, both in the way of entertainment and setting up the exhibit, if it is held in Chicago, which is centrally located and where most of the railway supply companies have permanent offices or representatives. There is a question as to whether suitable quarters can be secured for such an exhibit in Chicago. These are some of the problems which must be threshed out before arriving at a final decision.

The important thing is that the various associations are taking steps to resume their activities. Changed conditions and the long lapse between meetings make it vitally important to stimulate the work of these associations and get them to function on a more constructive and aggressive basis.

One other thing must be recognized and emphasized. There have been many changes in personnel in the past few years. Something must be done to help the men who have been promoted, and particularly the younger men. The latter have been largely lost sight of in the emergency. Fortunately, some of the older men have sensed the need of encouraging and developing this group. Let us hope that in some way they can definitely organize to draw out and develop these young men, so that they will be trained and fit for taking positions of leadership, as opportunity offers. Committee work, participation in the convention discussions, and the contacts they will make at the meetings, will be most helpful in training them for more responsible positions.

What to Weld—And How?

Railway locomotive and car maintenance practice, as well as reclamation work of all kinds, has been practically revolutionized in recent years by autogenous welding, the great bulk of which is now being done by the oxyacetylene and the electric processes. The whole subject of welding is beset with a multitude of questions. Safety is the first requirement in railway operation and, therefore, the first question regarding any weld relates to its safety and reliability. The next question is economy, since many welds which would be permissible or desirable from a safety standpoint entail a greater cost for material and labor than would be required to buy a new part. Once the mechanical and economic practicability of individual welding jobs is conceded, the question arises regarding what type of welding will give the best results and what detailed method can best be employed in preparing parts for the welding operation and treating them subsequently, if necessary.

An observation of current practice leads to the inevitable conclusion that all kinds of welding, good and bad, too extensive and too limited, are found in railroad shops and enginehouses at the present time. The final natural question, therefore, is: How can any railroad expect to achieve the best results with welding unless this important operation is put in charge of a specially trained general supervisor of welding who can co-ordinate the experience of mechanical supervisors on the entire system, check detailed welding operations with similar ones on other roads and with the most advanced methods in other industries, develop a standard welding practice folio for use at all points on the system, supervise the training of welding operators and see that periodic checks are made of their work?

Even a casual inspection of welding practice at many railroad shops and terminals indicates the widely divergent ideas regarding what can and cannot be done and emphasizes the necessity for a co-ordinated practice which will be well above present levels in many instances. Welding operations are being performed at

some shop points which are said to be impossible by supervisors at other points. Sometimes this difference of opinion exists at a single repair shop. For example, a general foreman at a small railroad shop recently examined a particular job and expressed the opinion that it could be welded. On assigning the work to his welding foreman, however, the latter explained that a similar welding operation had been performed only the preceding week and proved to be unsatisfactory.

All kinds of welding operations, building up worn parts, and facing certain parts with hard metal to give increased wearing properties and service life, must be carried on daily at railway repair shops. It is futile to expect that the best results of these operations can be obtained without an expert knowledge on the part of the men who do the work, supplemented by general instructions from some central authority familiar with what can be done and how. As previously suggested, the training of welders and periodic checking of test welds, also, should come under this same central authority. Only a few of the larger railroads have in the past made a practice of employing a general supervisor of welding and some of these men have been reduced to the ranks or secured employment elsewhere, owing to retrenchment programs which have so greatly curtailed supervision in railroad mechanical departments. It can hardly be questioned that this policy is a mistake and costly in the long run, since the supervisor's annual salary can readily be lost by mistakes of omission or commission on two or three important welding jobs.

Locomotive Smoke Elimination

Less than four years ago a Railroad Smoke Association was formed in Hudson County, N. J., to co-operate with the county administration in a campaign to eliminate smoke. The results have been most gratifying, the nine railroads serving this section making a particularly good record—a record which can be used to stimulate greater effort for improvement on the part of the industries and householders in that county.

In studying the monthly records of the railroads for these years it is interesting to note that some roads, which during the early part of the period were consistently near the bottom of the list, have shown a reversal of form and now stand near the top, although all of them have shown a marked improvement during the period. It has required a real effort to do this, with changes in methods and practices, but it has demonstrated clearly that it is possible to operate locomotives with very little, if any smoke. One road, the Lehigh Valley, headed the list four months this summer with 0.00 smoke. The Railroad Smoke Association, through its monthly meetings and the efforts of its officers and members, has carried on a steady campaign of education.

It may have cost something to make this record—undoubtedly it has. In some instances the grade of fuel has been changed; improvements have been made in the equipment and its conditioning. The elimination of smoke, however, means more perfect combustion and while accurate figures are not available, it is believed that the reduction in fuel consumption has more than offset the increased expense.

It is quite probable, also, that more or less intangible factors have resulted in savings in other directions. Industrialists, for instance, are quite generally agreed that cleanliness and orderliness are important factors in efficient production. The effort to eliminate smoke, and its accomplishment, apparently has a psychological effect upon the enginemen and does much to make them more careful as to all details of locomotive operation; in other words, there is an effect upon the morale, which while intangible, is believed to represent real and substantial improvement in more efficient operation.

It is claiming too much to say that the public appreciates the improvement which has been made—or that it even realizes that there has been an improvement in the reduction of locomotive smoke. This is not to be wondered at. The whole tendency in the business world in recent years has been to cater to the finer and more artistic instincts of the public. The manufacturers of common, every-day articles, which are to be found in the five and ten cent stores, have gone to considerable expense to design their products more artistically and to package them in an attractive and pleasing way. The Metropolitan Museum of Art in New York has an industrial division to assist manufacturers and merchants in these respects.

Stores—even the smaller ones and those away from the metropolitan centers—go to considerable effort to make attractive and artistic window displays, or to arrange their products on the counters and shelves in such a way as to appeal to the buyer. Moving picture theatres, restaurants, hotels and transportation companies have studied to make their facilities more inviting and comfortable; the decorator and artist have had a large part in this development. The same thing is true of the automobile manufacturer; even the makers of machinery and machine tools have emphasized the easy lines and more artistic appearance of their products. The artistic appeal is no more pronounced than in the advertising pages of the popular magazines and this is even carried over in certain respects into the daily newspapers. City administrations, although they may be confronted with serious budget difficulties, have not entirely lost sight of the necessity of keeping streets, highways and parks clean and orderly.

Under such circumstances the public expects that the railroads and the industries will do their part in reducing and eliminating objectionable features such as noise, smoke, objectionable odors and noxious gases. Indeed, the railways, if they do not do their part in improving these conditions, will be seriously criticised. The railroads of Hudson County are to be congratulated upon the showing they have made.

THE READER'S PAGE

Two Sides To This

To the Editor:

The writer has seen men promoted to supervisors in the car department from the ranks of both freight and passenger carmen. In many cases the promotion has been of a coach carpenter to supervisor in the freight-car shop, the party promoted being a first-class coach carpenter but inexperienced in the freight-car department. This meant a reduction in the output and, in many cases, a big loss to the company because of the man not knowing how to handle foreign equipment according to A.R.A. rules.

On the other hand, if the promotion had been made from the freight-car department the party would have had the proper knowledge of such handling which would have been for the good of the company.

Passenger-car work requires very little knowledge of A.R.A. rules, while everything pertaining to freight-car work requires a thorough knowledge of them.

W. H. Shiver.

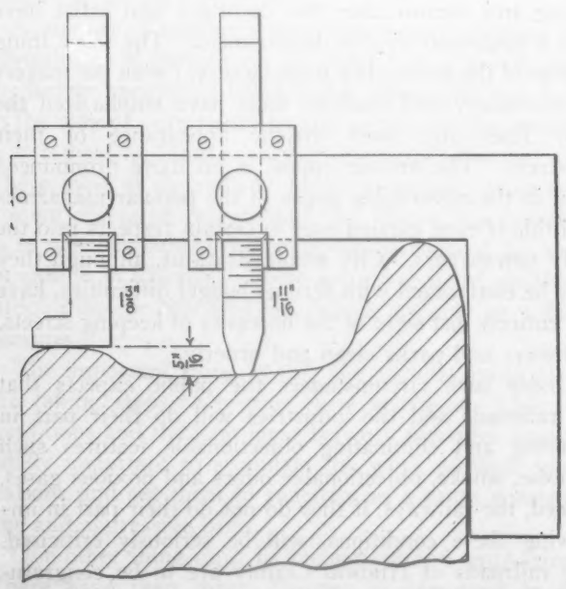
Tread Wear And Flange Height

To the Editor:

In the February issue of the *Railway Mechanical Engineer* you had an article on a gage to show tread wear.

From what I understand of tread wear, this gage is showing a measurement of flange height only and not tread wear. A flange height of $1\frac{11}{16}$ in. does not mean a tread wear of $\frac{9}{16}$ in., but whatever the difference between the highest and lowest parts of the tread, as I have tried to show in the sketch.

The gage I have illustrated was designed by F. A. Webb, car machine shop foreman of the Southern Pacific at Sacramento, Cal., a man who has spent 50 years on wheels and tires and who is an authority on his line of work. This gage is in three parts: a square of $\frac{1}{8}$-in. sheet steel and two movable heads with graduated slides. These are moved to the lowest and highest points of the tread so that the maximum wear might be obtained. In the sketch one gage shows $1\frac{11}{16}$ in. and the other $1\frac{3}{8}$ in. The difference of $\frac{5}{16}$ in. is the tread wear, and the $1\frac{11}{16}$ in. is flange height.



Gage for measuring both tread wear and flange height

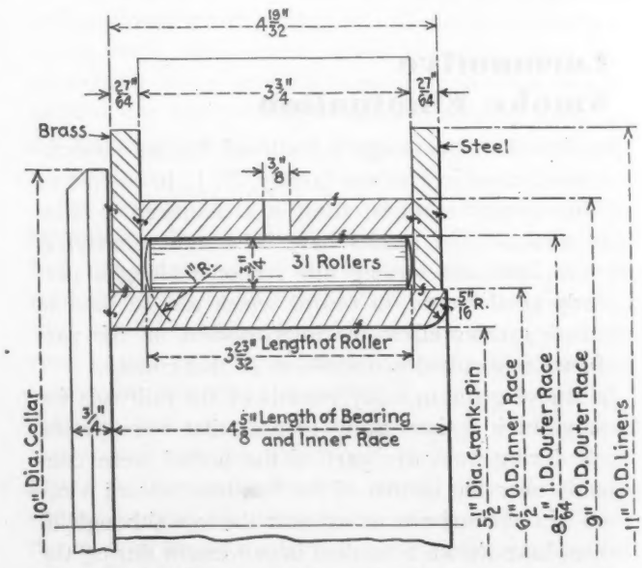
J. C. Hanssen.

Roller Bearings For Locomotive Rods

To the Editor:

A considerable number of the locomotives built in the past few years have been equipped with roller bearings on the axles of engine or tender trucks and in this field are giving such satisfactory performance that their advantages are quite generally recognized. In a few cases roller bearings have been applied also in driving axles but practically nothing has been accomplished in connection with their use for main and side rods until very recently.

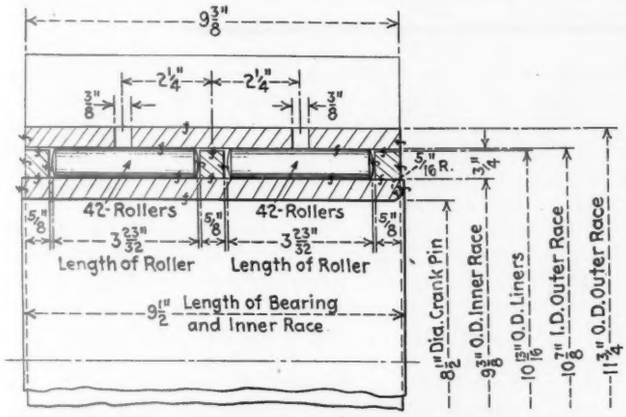
Floating rod bushings of both the solid and divided type were introduced several years ago and have attained wide usage. The solid type of floating bushing, if properly fitted, is a decided improvement over the pressed-in bushing. However, they very often are not properly fitted, especially at renewal periods in enginehouses and as a consequence, have caused considerable trouble. The divided, or split, type of floating bushing is much more reliable, but rapidly accumulates lost play unless carefully machined at the joints.



Roller bearing as applied to D. & R. G. W. side rods

While roller bearings have been considered for rod work, it generally has been thought that the servic-

would be too severe. Several years ago, however, the D. & R. G. W. decided to find out definitely whether roller bearings would stand up in this service. Accordingly, on November 13, 1931, a set of rollers was applied to a side rod at the left back crank pin on engine



Roller bearing as applied to D. & R. G. W. main rods

1523. This was perhaps the first installation of roller bearings for such service in this country. The locomotive was of the 4-8-2 type, built in 1923, by the American Locomotive Company. It has a weight of 267,000 lb. on the driving wheels, 28-in. by 30-in. cylinders, 63-in. drivers, 210 lb. boiler pressure and a rated tractive force of 66,640 lb.

The crank pin was 5¾ in. diameter with bearing 4½ in. long. A plain cylindrical bushing of vanadium steel, hardened and ground, was pressed into the rod, and a sleeve of the same material, 6¼ in. outside diameter, was pressed onto the crank pin. The twenty rollers were of a plain cylindrical design, ¾ in. in diameter by $3^{29}/_{32}$ in. long, made of vanadium steel, and mounted in a bronze cage with separation strips, $^{11}/_{32}$ in. thick between the rollers.

The service results were entirely satisfactory until, after a few months, the bronze age broke into several pieces. The cage, and a few of the rollers which showed signs of spalling, were removed at this time and the entire space filled with rollers, without any cage. These are still in service and have made approximately 50,000 miles. Analysis of the rollers removed showed that the tempering was not uniform. These had been made from a scrap piston rod.

In view of this experience it then was decided to tackle a harder job and in May, 1932, a set of rollers, made in the same way, was applied to the back end of the main rod on one side of engine 1518 of the same class. The general design is shown in one of the illustrations. No trouble of any kind was experienced with this application until July, 1934, when they were removed on account of wear, after about 30,000 miles. Both of these engines were used in heavy freight and passenger service.

On January 22, 1934, a set of rollers of the same design, but made of chrome-nickel steel, was applied to the side rod at the left back pin of engine 1700. This was a 4-8-4 type locomotive built by the Baldwin Locomotive Works in 1929. It has a weight of 252,000 lb. on the driving wheels, 27-in. by 30-in. cylinders, 70-in. drivers, 240 lb. boiler pressure and a rated tractive force of 63,700 lb. This locomotive is used in fast passenger service on 450-mile runs. Up to the present time, after about 35,000 miles, no trouble of any kind has been experienced. The lubrication used for all these bearings has been regular crank-pin grease, the same as used on all other engines. No dust washers or special fittings were used.

An interesting item in connection with these roller bearings is that the development of lateral play has been markedly less than with the conventional bearing. The service which has been given by these applications—which must be considered as rather crude—is such as to leave no doubt in regard to the practicability of rollers for any bearing in locomotive service. As a measure of comparison, the mileage which has been secured from floating bushings in comparable service averages 15,000 for main rods and 10,000 for side rods. Results thus far have been so satisfactory that we are now preparing to make a complete application to all side-rod bearings on another locomotive, and will also make further applications to main rods.

P. G. WITHROW,
Mechanical Engineer, D. & R. G. W.

* * *

Covered hopper car built by American Car & Foundry Company for bulk shipment of carbon black

Length inside	45 ft. 10½ in.	Truck wheel base	5 ft. 6 in.
Width inside	9 ft. 6 in.	Capacity	3,000 cu ft.
Height—rail to top running board	12 ft. 10⅝ in.	Axle journals	5 in. by 9 in.
Height—rail to eaves	11 ft. 10 in.	Light weight	50,000 lb.
Center to center of trucks	37 ft. 0 in.	Load limit	68,000 lb.

With the Car Foremen and Inspectors

Loading and Shipping Mounted Car Wheels

THE safe transportation of mounted car wheels between wheel shop and user point is always a more or less troublesome problem. The chief difficulties encountered are blocking, not only to prevent the wheels being knocked off the car in switching and train movements but to prevent surge movements of the wheels on the car. Adequate blocking to prevent inadvertent unloading in transit can be obtained by the use of substantial and well secured end and intermediate blocking. Preventing surge movements in the load and the resultant damage to axles in particular is much more difficult.

Slack develops in the load from indentations made by wheel flange and tread in end blocking, by more or less shift of end blocking, by indentation and shift of intermediate blocking. None of the ordinary blocking methods in use will prevent this shifting, and the greater the amount of slack developed the greater becomes the wheel movement impact, resulting in a still further increase in slack until there may be a total of several inches. The most serious consequence of this surge movement, however, is flange cuts in the axle of the next pair of wheels. These axle cuts are often so deep and extensive that the axle is or should be scrapped, as if returned to service it constitutes a serious menace in that a progressive fracture is likely to develop, leading to failure in service. Furthermore, each of these axle dents increases the total slack in the load by an amount equal to its own depth, which may be one-eighth inch or more, increasing the surge movement and the consequent damage to axles. A mild form of a flange-cut axle is shown in one of the illustrations. In some cases, new axles are so badly flange-cut in transit between wheel shop and user point that they have to be scrapped. Progressive fractures starting from these flange cuts not infrequently result in broken axles.

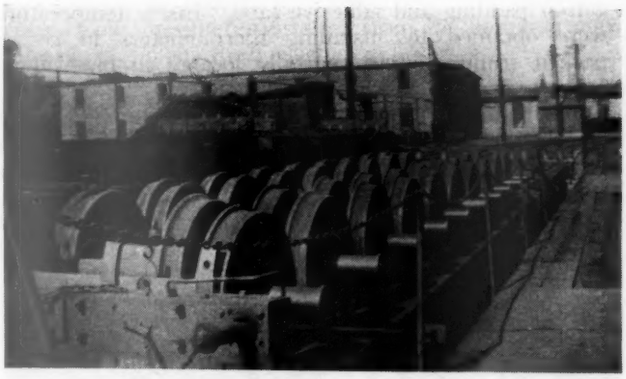
This serious trouble can be eliminated by the use of the axle protector, illustrated, which is a device patented by P. P. Barthelemy, assistant master car builder of the Great Northern, and now being introduced for general use on the railroads by the Universal Draft Gear Attachment Company, Chicago, Ill. As will be noted, this device consists of two malleable iron spacer blocks coupled together by a simple retaining spring arrangement. Each spacer block has a curved surface to engage the face of the axle, the radius of the curve being about that of the largest axles ordinarily shipped. The other side of each spacer block is trough-shaped to the contour of the wheel flange. The spring serves to keep the protector in place, and the trough for the wheel flange prevents the flange from coming in contact with the axle. This device offers so large a contact area to the flange that cutting slack becomes negligible. The protectors are easily applied and ordinarily will withstand many years of service.

After extensive experiments in loading and blocking wheels, the special wheel car illustrated was built and with the axle protector just described has served to eliminate blocking troubles. This special car has been found very effective, as besides making a much safer load than can possibly be had on the ordinary flat car it serves to reduce greatly the loading and blocking expense below that of the usual methods employed. Since ordinarily the shipment of bad order wheels to the wheel shop equals the number of OK wheels received, there is no empty car haulage nor serious idle car time.

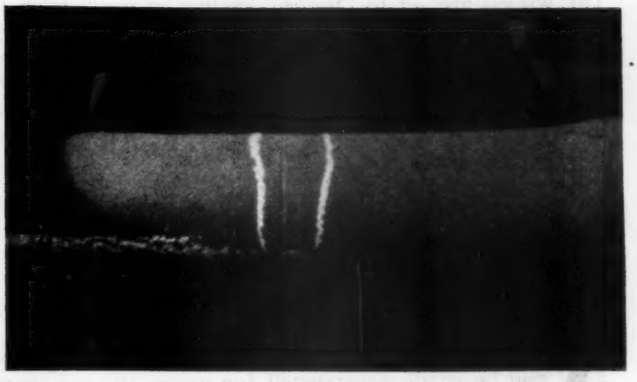
Metal-covered tracks are bolted to the car floor for convenience in loading and unloading and to insure proper lateral spacing of the wheels. The spread of these tracks is such that each wheel clears the end of the journal of the next pair thus obviating possible flange damage to journals that might otherwise occur, particularly when the load consists of mixed axle sizes.

Universal axle-protecting device as used to prevent damage by flange cutting

Special wheel car, the use of which is designed to eliminate blocking troubles



View of the special car as loaded with wheels ready for shipment



Car axle damaged at the center due to flange cutting while in transit on poorly blocked wheel car

With the guiding tracks mentioned each pair of wheels is automatically lined up on the car and may be easily rolled in place by one man, with no shifting for alinement on the car necessary. Better packing of the load is also more easily attained. This is particularly advantageous where wheels are loaded from one end of the car, be it by depressed track or hoist; the same applies to unloading.

The end blocking, the most important feature insofar as the safety of the load is concerned, consists of channel-re-enforced wood beams, secured to the car by means of heavy rods. The end of the rod passing through the beam is provided with a long thread and wood filler beams are also provided to compensate for any varying end projection which ordinarily occurs. The lower end of the rod is anchored in a large forging which is in turn securely fastened to the side sill of the car. The nut on the lower end is drilled and pinned to the rod, and lugs are welded to the rod to prevent rod rotation. When the end beam is removed the rods drop clear of the car floor so that they will not interfere with side loading or unloading when and if that becomes desirable.

A light crank is welded to the nut on the outer end of the rod for speed in removal and application, a wrench being necessary only for loosening or final pulling up of the nut as the case may be. A safety ring attached to a small chain is thrown over this crank to prevent the nut turning.

To prevent any bouncing of the wheels due to severe train surges or to careless switching, steel strap arcs bent to the contour of the wheel tread are secured to the end beams. A small chain is fastened to the top face of the beam so that it may be easily lifted on and off the car by means of the wheel hoist.

The foregoing has dealt with single-deck loading. Double-deck loading of mounted wheels is practiced on a number of roads and is covered by A.R.A. loading rules. What has been said regarding secure blocking applies also to this method of loading, differing somewhat, due to difference in load conditions. Where both wheel-shop and user point are equipped with suitable hoists for double-deck loading and unloading, a considerable economy results due to reduced car haulage, particularly where the haul is long and the wheel renewals are extensive. Absence of adequate loading equipment, with using conditions comparatively light, and the extra transit hazards to the double-deck over the single-deck load have had a tendency to limit the extensive use of two-tier loading.

Car-Shop Dolly

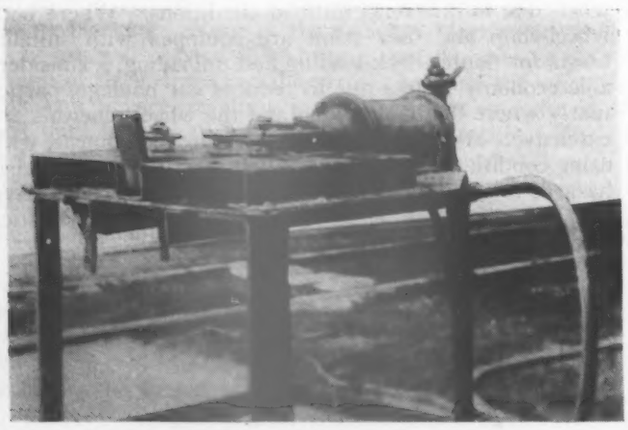
A CONVENIENT dolly which has many uses in and about car shops is shown in the illustration. It is made of two warehouse truck wheels, mounted on an axle, with a depressed center, to which is bolted a short length of channel iron cut from a scrap brake beam.

Convenient, two-wheel dolly used in moving heavy passenger-car truck equalizer, long steel sheets, etc.

The wheels are set to "toe in" slightly at the bottom to facilitate turning. In addition to the use illustrated, which consists of moving a relatively heavy passenger-car truck equalizer, this dolly serves effectively for the safe and ready movement of other heavy or awkward parts, such as long steel car sheets.

Pneumatic Pipe Bender For the Car Shop

AN efficient pipe bender, as shown in the illustration, can be easily constructed for use in the car shop. It consists of a 10-in. air brake cylinder mounted on a 30-in. table. A half portion of a ten-inch sheave wheel is attached to the piston push rod, the sheave wheel being of a size large enough to engage a piece of one and one quarter inch pipe. Several holes are drilled in the top of the table into which two sheave wheels, mounted on one and one quarter inch pins are dropped. The section of pipe that is to be bent is placed against the two sheave wheels and the piston of the cylinder moved out by air pressure to give the desired bend.



An easily constructed pipe bender

Aluminum Roof Paint Reduces Passenger-Car Temperatures

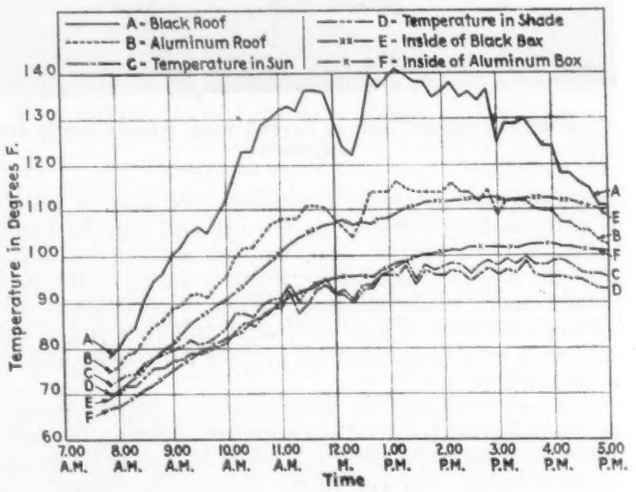
*By C. F. Griffith**

IN order to determine the relative merits of aluminum paint in comparison with the conventional black paint which is generally used on the roof of railway passenger-train cars a test was made in the following manner.

Two steel boxes, 18 in. by 18 in. by 18 in., were made of 14-gage steel and insulated throughout with three layers of three-ply Salamander insulation. Both boxes were painted in the usual manner with priming and black coats, while one of them was given a final coat of aluminum paint over the regular black paint.

Provisions were made for obtaining the temperature on the top sheet of each box, the inside temperature of each box and the temperature of the atmosphere in the sun and shade. Roof-sheet temperatures were obtained by holding the thermometer bulb in contact by the use of cotton padding and adhesive tape. Inside temperatures were obtained by installing thermometers in cotton-packed stuffing boxes centrally located in one side of each box.

The results of this test after being tabulated and plotted are shown in the accompanying diagram. As the material used in constructing, painting and insulating the boxes is similar to that used in railway passenger-car roofs, it is reasonable to assume that the interior tempera-



Temperature records in test of paints for passenger car roofs

tures observed in the test are comparable with those prevailing between headlining and roof sheets of railway cars when outside temperatures are equivalent to those shown. The temperatures observed and recorded in this test would have been much higher were it not for the fact that light to heavy fleecy clouds obstructed the sun rays at frequent intervals after 9.30 a. m. This interference is clearly shown in curves *A* and *B*.

Particular attention is called to the difference in interior temperature as shown by curves *E* and *F*, which was as much as 10 deg. F. for a considerable portion of the test. This shows conclusively that aluminum paint on the roof of a railway car will make possible the maintenance of lower temperatures inside of the car during periods of sunshine. Conversely, the aluminum painted roof should reduce the heating load in the winter season because of its lesser radiating capacity as compared to the black painted roof.

Reclamation of Air And Signal Hose Couplings

IT is essential that a careful inspection be made of air brake and signal hose couplings after they have been stripped from defective hose in the air brake shop and before they are reapplied to new tubes. They should be thoroughly cleaned before they are gaged and otherwise inspected and an excellent way of cleaning them is by placing them in a container as shown in the accompanying photograph and permitting them to remain in a "lye vat" for about 30 min. This will remove any

* Electrical engineer, Missouri-Kansas-Texas.

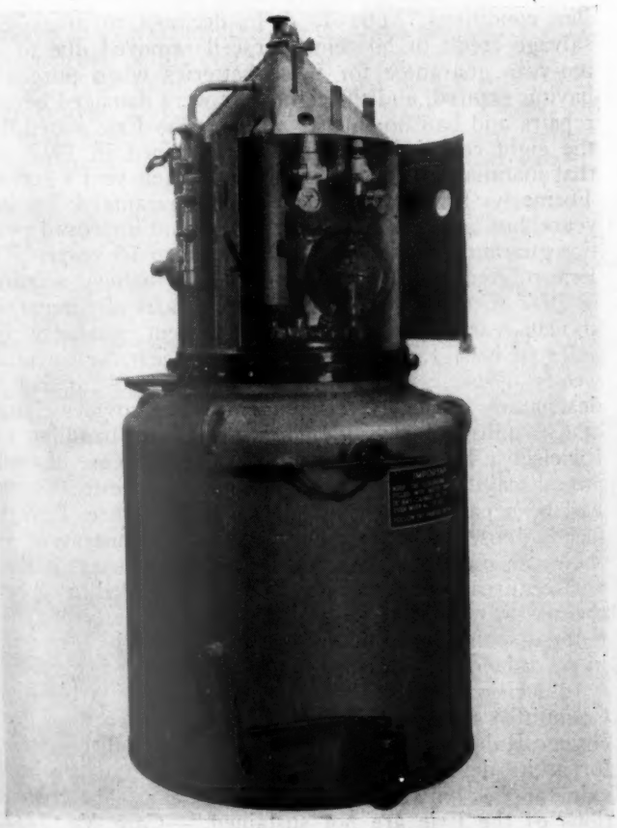
grease, paint or other substance from the coupling and will also clean out the gasket seat.

The same procedure is recommended for hose clamps. When all grease and paint is removed they can be more carefully inspected and cracks or defects can be more readily detected, esperially around the bolt holes.

Containers for air brake hose couplings and clamps

Oxweld Acetylene Generators

THE Linde Air Products Company, New York, has developed two new Oxweld acetylene generators, one being a small generator of the portable type and the other a stationary generator of much lârger capacity. The portable generator, designated as Oxweld type MP-4, has a capacity of 150 lb. of carbide and is rated to produce 300 cu. ft. of acetylene per hour. It weighs 750 lb. empty and 2,250 lb. fully charged. This generator has the largest rated gas capacity thus far approved for portable service and the smallest dead weight per unit of producing capacity.



Oxweld portable acetylene generator, type MP-4

The feed is of the gravity type with a self-contained feed-control unit bolted to the inside of the carbide hopper. The feed valve is adjusted to deliver gas at a pressure of about 13 lb. per sq. in., but this may be varied within a range of 2 lb. by external adjustment. At all rates of generation the pressure variation within the generator is not over ¾ lb. and this slight variation is nullified in the service line by a new type of regulator, Oxweld type R56. A simple filter unit, also within the hopper shell, is built into the rear of the regulator. The generator is designed to provide simple and rapid means for emptying and recharging, with ready accessibility of parts and easy maintenance.

The new automatic stationary generator, known as Oxweld type MP-5, is a high-capacity, medium-pressure model with a rated delivery capacity of 1,000 cu. ft. of acetylene per hour. In general appearance and principle it is similar to the portable type MP-4 generator. Both machines are listed by Underwriters Laboratories, Inc.

The hopper is provided with eyelets around the top so that it can be removed with a block and tackle. The regulator is Oxweld type R-57. A relief valve with an outdoor vent line is provided for the back-pressure valve and two other relief valves with a common outdoor vent line are provided for the generator chamber. A funnel and a 3-in. lubricated water-filling valve provide with an interference rod that operates a vent cock makes it impossible to add water until the cock is opened to allow for the displacement of gas.

Decisions of Arbitration Cases

(The Arbitration Committee of the A. R. A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Responsibility for Passenger Refrigerator Cars with Retaining Pipe Disconnected

N.R.C. passenger refrigerator car 317 and forty-five other passenger refrigerator cars were delivered to the Northern Pacific at St. Paul by the Chicago, Burlington & Quincy during June, 1932, with the retaining pipe disconnected or emergency reservoir pipes disconnected and capped, or both. The Northern Pacific finding it necessary to connect these pipes for movement of cars over their line, contended that they were entitled to defect card protection from delivery line to cover. The C. B. & Q. contended that no protection was due and declined to issue defect card to cover. There being no ruling of which the companies interested were aware, the matter was referred to the Arbitration Committee. The N. P. stated that cars referred to usually move into St. Paul in freight trains and again move out over N. P. in freight trains. It was their under-

standing that when either freight or passenger refrigerator cars are handled in freight trains, A.R.A. air-brake requirements, as well as federal safety appliance laws covering operation and condition of air brakes on freight trains, must be complied with. As A.R.A. rules require retaining valves on freight cars, it was contended that when passenger refrigerator cars are handled in freight trains they must also have retaining valves and their air-brake piping properly connected and in operating condition. To comply with these rules it was necessary to place cars on repair track and connect all pipes, involving considerable expense not only in making repairs, but also in switching cars to repair track, testing brakes, etc., for which the N. P. was unable to bill car owner. Request was therefore made of chief joint interchange inspector for defect card to cover, which request was declined. The C. B. & Q. having also refused protection, the matter was referred to the Arbitration Committee for decision. The C. B. & Q. stated that they had received these cars from connecting lines with retaining pipe disconnected and had moved them to St. Paul where they were delivered to N. P. in same condition. They knew of no interchange rule which makes a disconnected retaining pipe a cardable defect and did not consider it as such. Neither did they know of any rule prohibiting handling of cars with the retaining pipe disconnected or broken if brake is operative. Moreover, there has been more or less trouble on account of slid flat wheels under these cars in the past and it was evident that the thought of decreasing dangerous slid flat wheels prompted connecting lines to disconnect retaining pipes. Had retaining pipes been connected up, car owner could not have billed, neither could defect cards have been obtained from delivering line and, therefore, expense would have had to be assumed by them. C. B. & Q. does not use retainers on St. Paul line and simply passes cars along to N. P. in same condition as received from connecting lines.

In a decision rendered October 26, 1933, the Arbitration Committee said: "This is not a defect cardable in interchange. The company electing to connect or disconnect retainer or emergency reservoir pipes on passenger equipment cars for operation in freight or passenger trains must assume the expense incurred."—*Case No. 1731, Northern Pacific vs. C. B. & Q.*

Storage Batteries Damaged or Destroyed—Passenger Rule 22

A Texas & Pacific car moved in interchange service to the Erie at Chicago and thence to Jersey City, N. J., for discharge of lading. While car was on Erie dock electric lighting storage batteries and axle generating equipment were flooded due to unusually high tide. The T. & P. found one set of Edison A-4-H amp. storage batteries damaged beyond repair and requested defect card protection. The Erie offered to furnish a replacement set of batteries, either A-6 or A-6-H, of the same manufacture and approximate age, adjustment to be made based on depreciated value of batteries involved. Offer did not meet with approval of T. & P. as they wished to maintain their standard. The T. & P. further advised that test showed that eight battery cells were destroyed and balance could be repaired. The Erie acknowledged responsibility, but requested date on which batteries in question were manufactured with detailed statement showing hours consumed in making repairs. Also, owner was asked to allow credit in accordance with Edison practice for eight battery cells destroyed. The T. & P. would not agree to settlement on basis of depreciated value nor allow credit on basis of Edison depreciation code. It is desired that Arbitration Committee rule as to the propriety of settlement being based on depreciated value of cells in question and, if not, whether Erie should be allowed credit for destroyed cells in accordance with Edison code. The T. & P. cited finding damaged equipment on arrival of car at Ft. Worth and stated that they could not agree to accept a change in battery standards, and furthermore stated that damaged batteries had been reconditioned before exchange offer was received. Detailed bill showing cost of repair showed that it was necessary to renew eight Edison A-4-H cells out of a total of twenty-three to recondition battery which was purchased new in 1917. The Erie contended that charge against them for the eight cells renewed should be depreciated 69 per cent to cover 15 years expended life in accordance with latest adjustment guaranty published by the Edison Storage Battery Company which covers a life period of 16 years on a percentage scale allowance but excludes cells abused, lost or destroyed. The T. & P. contended that the Erie was responsible for the full cost to repair damage which was kept down to a minimum. The road has approximately 75 sets of batteries of this type of equal or greater age in operation which are at all times in first-class condition with cells rebuilt by manufacturer as required. Under A.R.A. interchange rules many car parts subject to progressive wear or deterioration which when renewed under like conditions are chargeable at cost without depreciation and we believe there should be no exception in this case. The argument that A.R.A. rental price of five mills per car mile compensates for electrical equipment seems entirely irrelevant since same might apply equally to any other part destroyed under like conditions. The T. & P. declined to allow Erie salvage credit of 50 cents per cell removed due to the ten-year guarantee for these batteries when purchased having expired, and the eight cells were damaged beyond repairs and had no salvage value. The Erie stated that the eight cells in question were obtained in 1917 and that manufacturer's guaranty was for ten year's service. Formerly Edison batteries were guaranteed for ten years, but later, based on experience and improved practice guaranty was gradually increased to 16 years. The Erie offered to settle for damage to a battery acquired in 1917 with ten years' guaranty on basis of current, or sixteen-year guaranty. Under present guaranty list price of cells 15 years old is 31 per cent, or, in other words, 69 per cent of life had been exhausted at time of destruction. Rule 10, Passenger Code, provides charge of five mills per car mile against the road handling car for electric lighting equipment to cover expense of operation, maintenance, depreciation and interest. Charge had been paid for this and other cars. Since T. & P. has had use of batteries or received remuneration for their use on other lines for the past 15 years, it does not seem reasonable that the Erie be compelled to replace them with new batteries and the Erie contends that settlement should be based on the service life which remains in accordance with Edison depreciation code.

In decision rendered October 26, 1933, the Arbitration Committee stated: "There is no provision in the Interchange Rules that a damaged part of car shall be settled for at its depreciated value. Settlement at depreciated value applies only in case of the entire car. The contentions of the Erie are not sustained."—*Case No. 1733, Texas & Pacific vs. Erie.*

In the Back Shop and Enginehouse

Universal Ram Type Turret Lathe

A NEW line of universal turret lathes of the ram type has been announced by the Jones & Lamson Machine Company, Springfield, Vt. These machines, which are of a completely new design and have many new production features, are built in two sizes—1½-in. and 2½-in. bar capacity. Two types of driving units are standard—motor mounted in the cabinet leg with drive through multiple V-belts or a flange type motor mounted integrally with the headstock. These machines may be used either for bar stock or for chucking work.

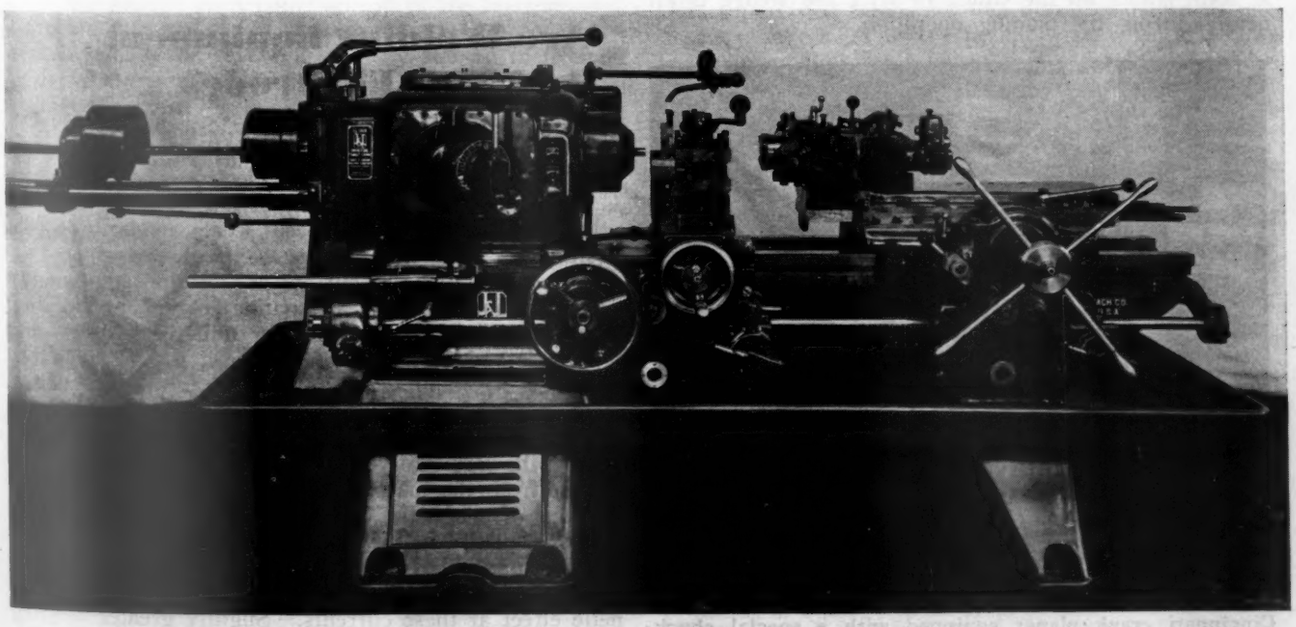
The fundamental purpose of this new design is to permit the use, at the highest efficiency, of the latest types of carbide cutting tools with ample margin for future developments in that field. At the same time there is combined in the same machine all the factors of mechanism, convenience and accuracy necessary to perform ordinary turret-lathe operations with ordinary tools at the highest available efficiency.

The headstock is provided with a single-lever dial selector which controls all speed changes. One lever controls the forward and reverse motion of the spindle and when moved to neutral position an adjustable brake for stopping the spindle is applied automatically. The machine has 12 selective forward and reverse spindle speeds, two ranges of which are standard equipment, namely: 20 to 1000 or 40 to 2000. This range covers the requirements of all cutting tools from carbon steel to carbide. The headstock is lubricated with a splash and filter system, and a visible oil-level gage is located on the front side. The bed is a double box-ribbed casting of rigid construction. The ways are of steel, carburized, hardened and ground. Leveling screws are provided in each leg of the machine.

The carriage is the universal bridge type, made exceptionally heavy for support of the many tools that may be in operation at one time. T-slots in the front and rear of the carriage cross-slide provide for multiple tooling. Standard equipment includes a square turret on the front and a dovetail tool slide on the rear. The square turret is controlled entirely by one lever. Each turret face is drilled so that a multiple tool block, with a capacity of four tools, can be mounted on each face. Maximum multiple tooling for rear-mount tools may be attained by means of dovetail tool blocks fitted to the tool slide. The carriage apron is equipped with a sliding-gear transmission for nine variable longitudinal and cross feeds, all controlled with a single lever dial selector. All feeds can be changed while the machine is running. The range of feeds for longitudinal travel is from .005 to .100 in. and the cross feed range is from .0025 to .050 in. per revolution of the spindle.

The carriage is equipped with a spool stop for longitudinal feeds and an adjustable stop bar, also a spool stop for the cross feed with adjustable stop dogs which will disengage the feed in either direction. The feed for the carriage is automatically disengaged as the carriage comes in contact with a stop, or it can be manually tripped. The feed knock-off is against a positive stop. The apron is provided with a feed reversing lever and a safety friction clutch is provided. For turning or boring tapers a standard taper attachment is bolted to the rear of the carriage. A thread chasing attachment, installed on the carriage apron, is also standard equipment.

The machine is fitted with a hexagon turret with all faces bored, counterbored and drilled for mounting standard bar and chucking tools and is indexed from one posi-



Jones & Lamson Universal ram type turret lathe with motor mounted in cabinet—The lathe is set up for bar work

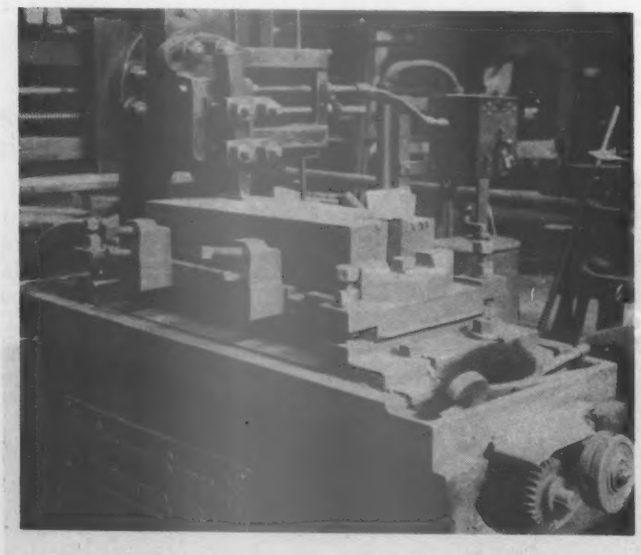
tion to the next with a star wheel. The turret is equipped with an automatic clamp ring. On the return movement of the slide the turret is unclamped, indexed to the next position and on the forward motion automatically clamped. It is equipped with six adjustable stops. The apron for the turret is equipped with nine variable feeds, all controlled with a single-lever dial selector. The range of feeds is from .005 to .100 in. per revolution of the spindle. The feed lever is automatically disengaged as the slide comes in contact with the stop, or it can be manually tripped. The cutting coolant is piped to the turret through the center pin and is distributed automatically to each turret face when indexed to cutting position. The bar chuck has a master collet fitted with removable jaws for different sizes and shapes of stock. By the use of a single lever the operator can unlock the chuck, feed the bar and perform all operations without stopping the machine.

Jig for Planing Shoes and Wedges

AT the Silvis (Ill.) shops of the Chicago, Rock Island & Pacific, two shoe-and-wedge planers are located adjacent to the center aisle of the erecting shop, near the locomotives which are being given general repairs, with a view to saving back travel of material and also conserving the time and extra steps of machinists who are assigned to line shoes and wedges and to notify machine operators what dimensions are required for individual locomotives.

One of the crank planers used for machining shoes and wedges is shown in the illustration, which indicates clearly the construction of a holding chuck especially designed for this service. The base plate of this chuck, which is bolted to the table of the machine, is roughly 15 in. wide by 33 in. overall. An adjustable steel plate, 9½ in. wide by 28 in. long, is machined as shown and provided with suitable stops and holding screws.

Referring to the illustration, it will be observed that a ¾-in. adjusting screw and lock nut is provided at each corner of the adjustable plate, and this permits easy and accurate adjustment to plane the proper taper on the wedge. Double ⅝-in. holding set screws are provided at four points on the chuck to hold the wedge down firmly during the planing operation.



Cincinnati crank planer equipped with a special chuck for use in planing shoes and wedges

Oil-Barrel Skids

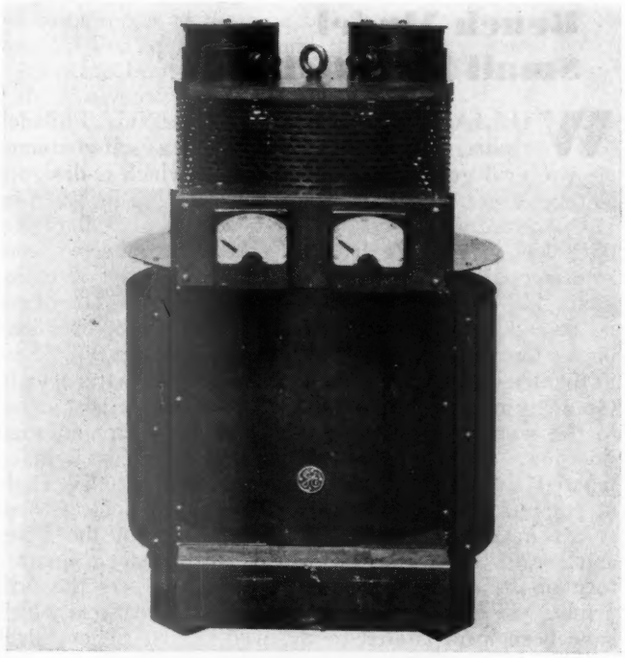
A PAIR of rail skids used in conveniently and safely handling barrels of oil or paint material is shown in the illustration. These skids, as well as the rigidly-supported rails, are used to provide proper storage for these barrels where they can be safely handled by one man. The rails are elevated slightly to keep the barrels off the ground, which prevents rotting or corrosion and also contributes to cleanliness. The skids at the rail ends consist simply of two tapered wooden blocks which are held parallel and in proper alinement by means of two one-inch round iron bars threaded and equipped with suitable positioning nuts. The use of these skids provides a much safer means of rolling barrels from the storage rails to the intershop roadway than loose planks or small timbers which are sometimes used.

Properly designed rail skids which promote safety in handling heavy barrelled materials

Arc Welding Equipment And New Electrodes

THE General Electric Company, Schenectady, N. Y., is introducing two new lines of arc welding equipment and two newly developed electrodes, one of which is suitable for Class I welds in any position and the other, high-quality, high-speed welds made in a flat position.

In addition to direct-current arc-welding equipment a complete line of G.E. alternating-current arc-welding equipment, including transformer units, electrodes, and automatic welding heads and control, is now available. The new a.c. equipment is intended for heavy current welding—primarily automatic, but equally suited to hand applications. The development of arc-welding electrodes during the last few years has now made it possible to benefit from the major advantage of the a.c. process—absence of magnetic blow in the arc and, therefore, superior quality in the resulting weld. This advantage becomes particularly apparent with the heavier welding currents—above 250 amp.—because of the greater magnetic effect at these currents. Slightly greater welding speeds are possible when using a.c. and full penetration



New General Electric alternating-current arc-welding machine

is obtained in corners and other difficult points.

Transformer units for these machines are available in three sizes having one-hour ratings of 500, 750 and 1,000 amp. Primaries are wound for 220, 440 or 550 volts; 60, 50 or 25 cycles; single phase. Extra attachments are available for obtaining currents down to 10 per cent of the one-hour rating.

A new line of portable, single-operator, arc-welding machines, designated as WD-30, incorporates recently developed refinements of which self-stabilization is an outstanding feature. Each welder is a self-contained unit, having no external reactor, resistor or separate exciter. It is largely due to the self-excited design of these machines that the inclusion of sufficient self-stabilization to provide steady welding characteristics under all conditions is possible. Separate controls are provided for adjustment of welding current and voltage. These controls are located on a panel on top of the machine at a convenient height. On this panel are also located a switch handle for reversing polarity and an instrument with selector switch for indicating welding current and voltage.

A new general-purpose welding electrode, designated as Type W-22, is of the heavily coated or shielded-arc type and produces welds of the quality required for Class I pressure vessels according to the A.S.M.E. Boiler Construction Code. Its distinctive feature is that it may be used in any position—i.e., for flat, vertical, or overhead welding—and at the same time has deep penetrating properties. It is, therefore, equally suitable for butt and fillet welds.

Tests on all-weld-metal specimens made from Type W-22 electrode show the following average results, which more than meet the rigid Class I requirements:

Tensile strength	65,000 to 75,000 lb. per sq. in.
Elongation	20 to 30 per cent in 2 in.
Impact resistance	30 to 45 ft.-lb. (Charpy)

In addition welded joints average 35 to 60 per cent elongation when tested by the free bend method and x-ray, Class I. Because these physical properties are obtained without regard to the position in which the welds are made, there is no necessity for moving the work so that welding may be done in a down-hand position. The W-22 electrode should have a wide field of application in locomotive boiler work.

Another new heavily coated, arc-welding electrode, designated as Type W-23 electrode, can be used in larger diameters (¼, 5/16 and ⅜ in.) and at higher current values than those commonly in use. Another characteristic is the fact that welds fuse uniformly with the side walls of the joint, thus saving the time and labor ordinarily spent in chipping out slag from pockets at the line of fusion. On most work the production rate is greater than with other heavily coated electrodes and two to three times the rate with bare or lightly fluxed electrodes. Welds are smooth and of excellent appearance and possess high tensile strength, density, ductility and resistance to impact and corrosion, more than meeting the requirements for Class I (A.S.M.E. Boiler Code).

Difficulties and Opportunities Of Enginehouse Foremen*

IT is rather difficulty to prepare a balanced paper on the difficulties and opportunities of the enginehouse foreman, as at the present time the former seem to so completely dwarf the latter. The depression, from which we hope that we are emerging, has greatly added to and enlarged his difficulties and the abolishing of positions, consolidations of work, elimination of terminals have considerably changed his outlook, particularly so far as promotions are concerned.

Among the difficulties I would list the effect of the depression on the safe performance of the worker. Under seniority rules and with drastic force reductions, the percentage of elderly employees has greatly increased. These men with years of experience are valuable and faithful employees but it is a fact that many of them refuse to admit or concede that they are less active and alert than formerly and for that reason have to be more closely watched and more carefully supervised to prevent personal injuries.

Constant and Alert Supervision Essential to Safety

It is also a recognized fact that without constant and alert supervision mechanics will unconsciously drift into unsafe practices. This is especially true when it is close to departing time for a locomotive and work is uncompleted. Our safety department heads, as well as higher mechanical officials, hold the foreman responsible for injuries in his department.

Of our few injuries, a majority are caused by employees doing something against existing instructions, and a close investigation will show that the particular individual has not only probably indulged in the unsafe practice before, but that it was only good fortune and breaks that prevented his injury at some previous date. We don't hear much about the injuries we prevent, because that is part of our business and what we are trained and paid for. It is the injury that is not prevented that holds the limelight.

The Form 87 report covers engine failures. On the Santa Fe, we class as an engine failure a passenger train delayed five minutes and not making up the lost time on the division; also a freight train delayed 15 minutes and not making up time on the division. In other words, something our inspectors might have seen or possibly a different handling of the situation by the engineman.

* Abstract of a paper presented by D. R. Cook, roundhouse foreman, Atchison, Topeka & Santa Fe, Richmond, Cal., before the Pacific Railway Club, on June 14, at San Francisco, Cal.

A mechanical inspector spends 20 to 30 minutes on a locomotive, with its thousands of parts. Due to being familiar with the different locomotives, he is well versed in knowing what is apt to cause trouble. On the outgoing inspection, he spends another 30 minutes, but 15 to 20 of this is on the air test. Under such conditions, he may slip up on something which is very embarrassing to explain.

Another difficulty, which may be traced to the depression, is the practice on many railroads of lengthening out the mileage between shoppings. This practice frequently results in increased maintenance work which is thrown on an enginehouse that, because of reduced force, is not in a position to handle the work properly. But, I believe, it is a good, safe practice, if not carried to extremes and will result in reduced maintenance cost.

All Foremen Think They Need More Men

There is something peculiar about enginehouse foremen. I have yet to meet one who does not think he needs more men and if he were given all the men he wanted I don't believe it would increase his miles per failure or cut down his terminal delays. I am firmly convinced he would increase his enginehouse expense, both as to engine handling and maintenance, to an unreasonable point.

Enginehouse foremen are infected with hobbies. I recall one foreman of my acquaintance who was always setting valves, another who every time I went through the house had the engine trucks out of two or three locomotives and still another who kept about half the force busy on main rods.

As the enginehouse foreman is practically the master mechanic's eyes for getting proper information for monthly power meetings, it is necessary for him to keep a record of each individual locomotive as to its mechanical condition. There are many jobs he is figuring on doing at the first opportunity, he being governed in this by the length of time the engine will be in and how other work lines up. My particular hobby has been trying to avoid the letters we get covering things that should have been done.

Statistics are just like a barb-wire fence around some green pastures. They fiercely and ruthlessly give you your cost on many items as compared with the entire system and other divisions. In other words, they show you what you are really doing—not what you think you are doing. If you are not up with the system average something is wrong and the comparative statement shows about where it is.

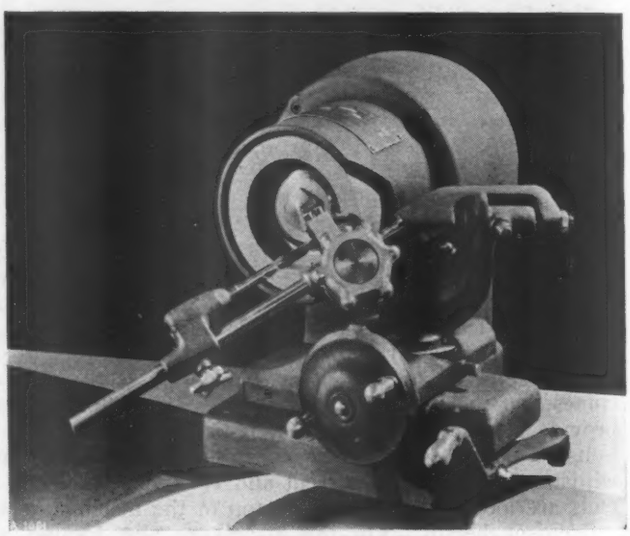
Comparative Statistics Provide Competitive Urge

About a year ago our division was running an excessive cost of rod bushings. Our master mechanic, after carefully checking the figures, came to the conclusion it must be due to wedges. We had been receiving no reports from enginemen on wedges but on checking up on our Pacific-type locomotives we found the main wedges in good shape, but the front and back not properly adjusted. This was putting a strain on the bushings and after being corrected, put our rod cost where it belonged.

An enginehouse foreman has unusual opportunities for service. He is literally on the firing line. The back-shop foreman works more or less by theory, but the enginehouse foreman has before his eyes daily the practical application of those theories. He sees every result of changes in repair work in the back-shop and he is, therefore, in a position to make valuable suggestions for improvement. He is also in a position to see that repair material gives the full maximum service before being replaced.

Bench Model Small Drill Grinder

WILLIAM SELLERS & CO., INC., Philadelphia, Pa., has brought out a self-contained electric drill grinder of the bench type which is designed to take care of small drills ranging from 1/16 in. to 1/2 in. in diameter. This tool, which is known as Sellers No. 05D drill grinder, is driven by a direct-connected, constant-speed, built-in electric motor of 2/3-hp. size, for either 110- or 220-volt, single-phase current. The motor is provided with push-button control and over-load protection. The grinding wheel is of the cup type, 5 in. in diameter and mounted directly on the armature shaft. Grade, grain and bond of the wheel are those best suited to the work, permitting quick grinding with minimum dressing. Two-lip twist drills, with either straight or tapered shanks, may be ground to any included angle of point from 80 to 160 deg. The drill is held at three points in a check which grips the edges of the flutes as close to the cutting lips as possible. Only a quarter turn of the clamping knob is required to grip the drill firmly. This tool embodies the essential features which have been incorporated in the well-known Sellers' drill



Sellers No. 05D bench drill grinder

grinders of larger size and produces automatically lips of equal angle, length and clearance, with the clearance increasing properly toward the center. The operation of the machine is so simple that a skilled operator is not required. The weight is approximately 110 lb. The bench space occupied is 16 in. by 13 in. and the overall space 23 in. by 18 in.

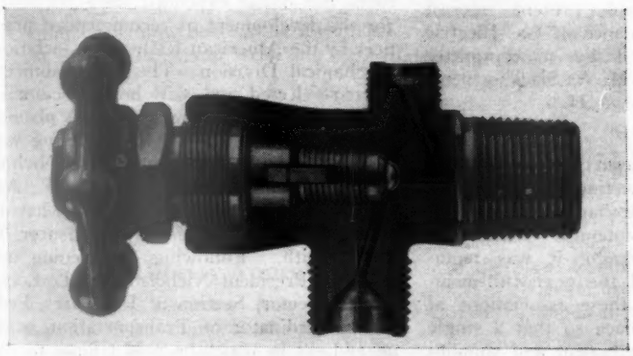
Brazing Outfit and Oxygen Tank Valve

AN acetylene brazing outfit, known as "Aircobraze," has been brought out by the Air Reduction Sales Company, New York. This outfit is especially suited for use in installing Walseal treadless bronze fittings, although it is also entirely suitable for any pipe welding. With this outfit connected to the gas cylinders it is only necessary to slip the brass pipe into the Walseal fitting until it butts against the shoulder and apply the Airco-

braze process to the pipe and fitting until the white ring of Sil-Fos appears around the pipe—evidence that the joint has been made. This outfit will be distributed by the Walworth Company, Boston, Mass.

The Air Reduction Sales Company has now equipped most of its oxygen cylinders with valves having a stainless steel ball which forms the seat. The valves open and close easily, are said to possess superior sealing qualities and do not corrode or score and cause leaks. For over three years similar types of hardened stainless steel ball valves have been used on all Airco-DB welding and cutting torches. Torches so equipped have rarely required valve repairs other than the occasional renewal of valve-stem packing.

Aircobraze oxyacetylene outfit



Airco ball-seat valve for oxygen cylinders

Eliminating Hairpin Keepers

By A. Robeson

IT is generally acknowledged that the castle nut and cotter are the most effective nut-locking device as well as the simplest; and their general adoption has largely excluded the use of various nut locks, patented and otherwise. In the days when locomotive crosshead pins were lubricated from an oil cup in the main rod or on the side of the crosshead the castle nut and cotter could be used to advantage. When grease lubrication for the front end of the main rod was found more satisfactory than oil and was generally adopted the grease cavity through the center of the pin prevented the use of an ordinary castle nut and cotter, and a style of nut lock known as the hairpin keeper, Fig. 1, was introduced. This is simply a piece of ¼-in. round iron bent like a hairpin which is inserted in two holes in the pin drilled off center enough to miss the central grease cavity which is about an inch in diameter. This keeper is satisfactory, especially if the nut is slotted out to receive the keeper as shown in Fig. 2. A half-inch spring-wire cotter key and castle nut would be even more secure, and to permit the use of such a cotter on a grease-lubricated pin the arrangement shown in Fig. 3 was adopted. Instead of taking grease from an alemite fitting or grease cup on the end of the pin, the grease fitting is welded on the side of the crosshead. A hole is drilled down through the taper fit and into the pin where it connects with the grease cavity which is drilled from the back of the pin and does not extend into the threaded portion. This cavity is closed by a brass plug screwed in the back of the pin. The dowel in the pin keeps the holes lined up. Occasionally it is necessary to chip out the hole in the pin, especially after the pin has been refitted in the lathe and the shoulders set back.

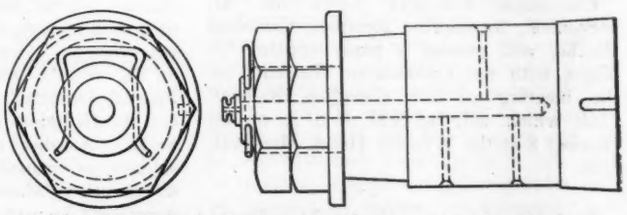


Fig. 1—Hairpin keeper applied to crosshead pin with Alemite grease fitting

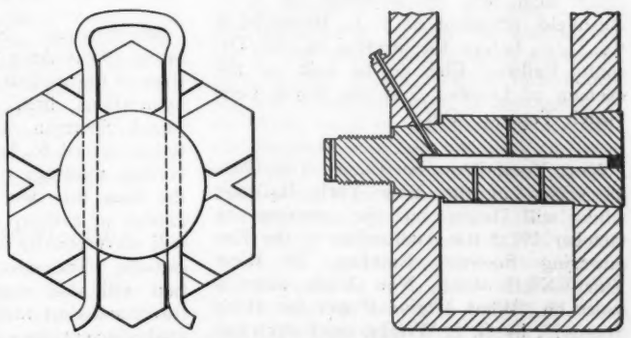


Fig. 2 (left)—Nut slotted for hairpin keeper

Fig. 3 (right)—Grease connection on crosshead permits use of ordinary castle nut and cotter

In this connection it might be mentioned that no locomotive is too old to have its lubrication modernized by installing a set of modern grease fittings that can be lubricated with a pressure gun. The old style of filling rod cups with a hand wrench passed out of the modern shop before hard times came in.

BRING 'EM BACK ALIVE.—For three days, passengers using Dearborn station in Chicago were treated to the spectacle of a monkey racing about among the rafters of the train shed, and eluding the most persistent efforts at capture. Eventually though, someone evidently experienced in the power of feminine wiles brought over a female monkey and caged her near a trap. It wasn't very long until the fugitive, listening, as so many of us have, to the call of the false siren, went in search of her and was duly caught in the trap.

Among the Clubs and Associations

RAILWAY CLUB OF PITTSBURGH.—"What of the Railroad Future?" was the subject discussed by John J. Cromwell, general counsel of the Baltimore & Ohio, before the September 27 meeting of the Railway Club of Pittsburgh.

NORTHWEST CAR MEN'S ASSOCIATION.—M. C. VanGundy, consulting chemist, Texas Company, presented a paper on the manufacture and uses of petroleum products at the October 1 meeting of the Northwest Car Men's Association.

CANADIAN RAILWAY CLUB.—W. H. Stevenson, locomotive foreman, Canadian Pacific, will present a paper entitled "A Night with the Locomotive Foreman" at the meeting of the Canadian Railway Club which will be held at 8 p. m. on October 8 at the Windsor Hotel, Montreal, Que.

TORONTO RAILWAY CLUB.—The Diesel Engine, Its History, Developments and Application, particularly in the transportation field, will be discussed by J. L. Bushfield, president of J. L. Bushfield & Co., Ltd., before the meeting of the Toronto Railway Club to be held on the evening of October 5 at the Royal York Hotel, Toronto, Ont.

NEW YORK RAILROAD CLUB.—The 1934-35 season of the New York Railroad Club will begin on the evening of October 19 at the Auditorium of the Engineering Societies Building, 29 West Thirty-Ninth street, New York, when a paper on "What Motive Power for High Speeds?", by G. I. Wright, chief electrical engineer, and P. A. McGee, assistant engineer, of the Reading, will be presented. The paper will be a study of main-line and suburban passenger trains, evaluating the effects of train shape, size and weight on the cost of power with steam, electric and oil-electric motive power at speeds up to 125 m.p.h. It will develop power requirements and estimated costs of operation for all lengths of trains and for a wide range of speed and give cost comparisons of conventional and light-weight trains of the lengths considered. ¶ The members of the Metropolitan Section of the American Society of Mechanical Engineers and the members of the American Institute of Electrical Engineers have been invited to participate in this meeting.

GENERAL FOREMEN'S ASSOCIATION.—After a lapse of four years a meeting of the International Railway General Foremen's Association was held at the Hotel Sherman, Chicago, September 17 and 18, with President A. H. Keys, district master car builder, B. & O., presiding, and Secretary-Treasurer William Hall in charge of the general arrangements. The principal address was made by C. M. Darden, superintendent machinery, N. C. & St. L., who stressed the importance of railway shop supervisors in maintaining equipment in proper condition to sustain modern, high operating speeds and severe service conditions. Mr. Darden also emphasized the need for the maintenance of high standards of workmanship and at the same time keeping shop costs low, these two somewhat conflicting requirements being kept in the proper balance by the good judgment of shop superintendents, master mechanics, general foremen, enginehouse foremen and, in fact, all shop and enginehouse supervisors. ¶ One of the most important of the reports was that on "Minimizing Federal Defects," presented by Chairman C. M. Hillman, general foreman, M. & St. L. Another committee report on a subject of considerable present interest was entitled "Maintenance of Gas-Electric Equipment," prepared by a committee headed by Chairman M. A. Slack, general foreman, N. Y., N. H. & H.

MECHANICAL SUPERVISORS' CONVENTIONS 1935.—At a meeting of representatives of the various mechanical supervisors' associations, held September 18, at the Hotel Sherman, Chicago, it was tentatively agreed to held the next full-membership meetings of these associations at the same time and place so that a single exhibit of railway equipment and supplies will serve equally well for all of the associations. The selection of a central location will also contribute to economy in travel and thus facilitate resuming the annual conventions, which, in some cases, have been discontinued for a period of four years. ¶ Tentative plans have, therefore, been made to hold the next annual meetings of these associations in two groups, early in May, 1935, at the Hotel Sherman, Chicago. The first group, including the Traveling Engineers' Association, Air Brake Association, International Railway General Foremen's Association and the Car Department Officers' Association, will hold individual but simultaneous meetings on Thursday, Friday and Saturday, May 2 to 4, inclusive. The second group, including the International Railway Fuel Association, Master Boiler Makers' Association, American Railway Tool Foremen's Association and International Railway Master Blacksmiths' Association, will meet on Monday, Tuesday and Wednesday of the following week. Recommendations from these associations will thus be available in time for consideration at the meeting of the American Railway Association, Mechanical Division, which it is planned to hold at Atlantic City, N. J., in June, if business conditions permit. ¶ The exhibit in connection with the 1935 meetings of the mechanical supervisors' associations at Chicago will be provided by the Allied Supply Association.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—In the first annual meeting since May, 1930, over 180 members and guests gathered for a two-day session at the Hotel Sherman, Chicago, September 17 and 18. While the program was shorter than usual and there was no accompanying exhibition of railway equipment and supplies, the meeting was a pronounced success from the point of view of general importance of the subjects discussed and the keen interest in these subjects as evidenced by the extensive discussion. An unusually important action was taken at the close of the meeting when seven specific items bearing on the attainment of maximum fuel returns per dollar expended were suggested for the development of recommended practices by the American Railway Association, Mechanical Division. The present officers were re-elected and will hold office until the next annual meeting which it is planned to have in May, 1935. ¶ The meeting was presided over by President J. M. Nicholson, master mechanic, A. T. & S. F., Argentine, Kans., the general program having been developed by Secretary-Treasurer T. Duff Smith. Following an opening address by President Nicholson, R. L. Lockwood, director, Section of Purchases, Federal Co-ordinator of Transportation, made an address in which he paid tribute to the constructive character of the association's activities in the past and expressed his desire to help co-ordinate the activities of the railroads in securing improved fuel purchasing methods. Carroll B. Huntress, president, Appalachian Coals, who addressed the association as a representative of the coal industry, said that the railroads should co-operate more fully with the producers, as, for example, in the use of screenings on stoker-fired locomotives, and other sizes of coal not in urgent commercial demand. Lawrence Richardson, mechanical assistant, B. & M., discussed the subject of locomotive performance, stating that it is not possible to reproduce in actual practice results obtained when using a dynamometer car, unless engine crews are given the necessary indicating and recording equipment to show them when the most efficient operation is being secured. Committee reports were presented on the following subjects: Fuel Distribution and Statistics; Storage, Oil and Coal; Front Ends, Grates and Ash Pans; Locomotive Firing Practice, Oil and Coal; Fuel Stations; New Locomotive Economy Devices; Stationary Boilers; Steam Turbine and Steam Condensing Locomotives and Inspection and Preparation of Coal.

NEWS

THE CHICAGO, MILWAUKEE, ST. PAUL & PACIFIC is making plans for the construction of a sandblast building at its locomotive and car shops at Milwaukee, Wis.

THE SOUTHERN RAILWAY will retire from service and scrap 4,973 units of equipment, consisting of 112 locomotives, 40 passenger train cars, 4,492 freight train cars, and 329 units of work equipment. The company is now negotiating a contract for the sale of the scrap steel.

THE CAMBRIA & INDIANA is asking for bids on changing 1,000 of its cars from arch bar trucks to cast steel side frames, on the basis of applying suitable second-hand cast steel side frames and truck bolsters if such are available and if they will meet the specifications of the A.R.A.

Code Authority Approved

THE National Recovery Administration has announced its approval of the method of selecting the personnel of the Code authority for the locomotive appliance industry as follows: M. Schiller, vice-president, the Superheater Company, New York City; Henry Jude, assistant sales manager, Consolidated Ashcroft-Hancock Company, Inc., New York City; Elliott Curtiss, president, U. S. Metallic Packing Company, Philadelphia, Pa., and G. W. Alcock, assistant secretary, Lima Locomotive Works, Inc., New York City.

I. C. Crafts Vote on Unions

IN a referendum conducted by the National Mediation Board, shop employees of the Illinois Central on August 30 chose to be represented by the standard unions instead of company unions. Machinists, boiler-makers, blacksmiths, sheet metal workers, electrical workers, carmen, firemen, oilers and coach cleaners were involved. This referendum under which employees choose between company and outside unions is the first large one conducted by the mediation board since its appointment. Requests for similar referenda among employees of other large carriers are being prepared by the American Federation of Labor. In the I.C. election 9,000 employees were eligible to vote and approximately 90 per cent availed themselves of the privilege.

Chinese Railways Want Second-Hand Equipment

SECRETARY ROPER of the Department of Commerce has made public a letter from James Harvey Rogers, who has been in China for some time making studies for the United States government in connection with the monetary situation, stating that he had been asked by Chinese railway officers to call attention in this country to the great demand in China for second-hand railroad equipment. Such equipment is desired on a credit basis, to be paid for out of earnings, but there has been a suggestion of a possibility of financing it through the Export and Import Bank.

Trade Practice Complaints Committee for Car Appliance Industry

THE National Recovery Administration has approved a plan of organization and precedure for the trade practice complaints committee of the railway car appliances industry, a division of the fabricated metal products and manufacturing and metal finishing and metal coating industry. The members of the committee now authorized to proceed with the adjustment of trade practices are: S. L. Beymer, treasurer of the Hutchins Car Roofing Company, Detroit, Mich.; G. N. DeGuire, president of the Ajax Hand Brake Company, New York; C. D. Jenks, president of the Chicago-Cleveland Roofing Company, Chicago; and A. C. Moore, president of the Chicago Railway Equipment Company, Chicago.

Shopcrafts Hold Meeting

THE first annual convention of the Brotherhood of Railroad Shopcrafts of America which came into existence on July 6, following a two-day meeting at Chicago called by the Allied Independent Railroad Labor Organizations of Western Lines, was held in that city on September 4-6. The organization, which is opposed to affiliation with the American Federation of Labor, elected the following officers: President, H. G. Kinney, of the Southern Pacific, Sacramento, Cal.; vice-president, Walter Franklin, New York; national organizer, Theodore Davis of the Pennsylvania, New York; and secretary-treasurer, J. I. McConnel, of Topeka, Kan. They chose St. Louis, Mo., as the place for the next convention.

Equipment Improvement Programs

THE ILLINOIS CENTRAL has embarked on an extensive program of improvement of its passenger equipment, which includes the extensive repair, rebuilding and modernizing of 162 steel cars, including 30 mail, 27 baggage, 11 baggage-smoker, 37 coach, 22 compartment-coach, 9 chair, 13 dining, 6 club, 5 parlor-lounge, and 2 cafe-lounge

cars. In addition, 24 steel underframe coaches and head-end cars will be repaired. This work, to be done by company forces at Burnside shops, Chicago, is now well under way and 73 cars have already been completed and returned to service. Air-conditioning equipment will be installed in all of the 24 diners, club and parlor-lounge cars. Of the 162 all-steel cars to be reconditioned, approximately 100 will be repaired in kind and the remainder will be practically rebuilt, re-decorated and re-equipped, making them the equivalent of new cars, in so far as modern conveniences are concerned.

The Baltimore & Ohio program to cost $4,279,244, which included the reconditioning of 240 locomotives, making heavy repairs to 4,800 freight cars and reconstructing 200 automobile cars, as announced in the April issue of the *Railway Mechanical Engineer*, has been modified and now calls for repairs to 100 additional locomotives at an estimated cost of $4,500 each and repairs to approximately 7,000 freight cars at an estimated cost of $150 a car. Work has already been completed on the 240 locomotives at a cost of $1,077,863. 200 automobile cars at a cost of $128,145 and 732 of the 4,800 freight cars at a cost of $309,603—a total cost, advanced by the Government, of $1,515,611, leaving a balance of $1,484,389 to be advanced on account of the repairs to 4,068 freight cars. The road now proposes to use the unexpended balance allotted for repairs to the 4,800 freight cars in repairing an additional 100 locomotives and approximately 7,000 freight cars. The proposed changes have been accepted by the Federal Emergency Administrator of Public Works and have been approved by the Interstate Commerce Commission.

Plan for Purchasing Board Dropped After Experiment

EXPERIMENTS with the plan proposed by the Federal Co-ordinator of Transportation to establish reviewing boards of purchasing officers to receive and study orders placed by railroads on manufacturers for materials have been concluded after six Chicago railroads submitted copies of their orders daily for a two months' period, and the plan has been abandoned, according to information issued by the

Purchases and Stores division of the American Railway Association to its members. In order to provide a direct means for the Director, Section of Purchases, Federal Co-ordinator, to obtain information desired on subjects of a general nature, which do not come under the scope of work considered by the regular subject committees of the division, it has been decided that the group meetings of purchasing officers will be extended and established in all territories under the direction of the division in place of the original reviewing board plan, the report states. It is felt that through this method better results will be secured in promoting uniformity in practice and the adoption of standards.

The various groups and the chairmen of each group are as follows: Eastern group, A. W. Munster, vice-president, Boston & Maine, Boston, Mass.; Southern group, J. L. Bennett, purchasing agent, Central of Georgia, Savannah, Ga.; Western group, D. C. Curtis, chief purchasing officer, Chicago, Milwaukee, St. Paul & Pacific, Chicago; Northwestern group, C. C. Kyle, purchasing agent, Northern Pacific, St. Paul, Minn.; Southwestern group, J. H. Lauderdale, general purchasing agent, Missouri Pacific Lines, St. Louis, Mo.; Far Western group, U. K. Hall, general purchasing agent, Union Pacific system, Omaha, Neb. The chairman of the division will be chairman ex-officio of all groups.

A special purchasing group advisory committee has also been selected to formulate uniform plans and policies to be followed by the several purchasing groups, the committee consisting of: F. D. Reed (chairman), purchasing agent, Chicago, Rock Island & Pacific; M. J. Collins, general purchasing agent, Atchison, Topeka & Santa Fe; A. C. Mann, vice-president, Illinois Central; and C. E. Walsh, general purchasing agent, Pennsylvania.

Meetings of the Western group were held in Chicago on July 11 and August 14, while the Eastern group held a meeting in Boston on July 18 and the Southern group held a meeting at Atlanta, Ga., on July 19. R. L. Lockwood, Director, Section of Purchases, Federal Co-ordinator, attended the Boston meeting, and H. P. Dalzell, of the Section of Purchases of the Federal Co-ordinator, attended the meeting at Atlanta. Steel prices, coal prices, the construction code and sales were considered at Chicago, while subjects considered by the Eastern group included the purchase and sale of surplus and second-hand material, the sale of obsolete equipment and rail, the simplified invoice form, interest on invoices under the steel code, the use of A. R. A. and A. R. E. A. lumber specifications, bituminous coal, contracts, discount allowances to governmental purchasing agencies and description and specifications in purchasing orders. The codes for construction, bolts, nuts and rivets, lumber, cross ties, steel castings and envelopes were discussed at Atlanta; also oxyacetylene rentals, material stores expenses, coal prices and the commercial clauses of the iron and steel code.

More Than Half of P.W. A. Railroad Loans Paid Out

More than half of the $190,950,500 allotted by the Public Works Administration as employment-creating loans to 31 railroad companies has been paid out and on July 15, the latest date for which complete figures are available, 70,060 men were directly employed as a result of these loans, with probably a considerably greater number of men and women indirectly employed. Payments on loans totalled $95,904,000. This was the report made to Public Works Administrator Harold L. Ickes by Frank C. Wright, director of the Division of Transportation Loans.

Itemizing the direct employment created by the P.W.A. program of loans, Mr. Wright reported:

(1) That 20,533 railway shopmen were employed in the shops of 14 roads to which P.W.A. made loans totalling $51,905,043 for repairing and rebuilding old cars and locomotives and building new ones in their own shops.

(2) That 35,902 track men and other classes of outside railway employees were working on right of way improvements being made by 19 railroads as a result of $77,075,957 of loans made by P.W.A. to finance those improvements.

(3) That 13,625 men were employed in the shops of locomotive and car-building companies which have received orders for new cars and locomotives as a result of P.W.A. loans totalling $61,969,500 to 18 railroad companies for purchase of new equipment.

The indirect and industrial employment created by the placing of orders for approximately $100,000,000 worth of materials cannot be accurately stated. Among the railroads reporting the largest number of shopmen at work were the Southern Pacific, with 5,926 men employed in its shops and roundhouses; the Pennsylvania, with 3,447 men; the Illinois Central, with 4,187 men; and the Great Northern with 2,289 men.

The stimulus that the P.W.A. loans for purchase of new equipment has given to the long dormant car and locomotive building industries is indicated by the fact that out of 19,272 men employed in the shops where P.W.A. financed equipment is being assembled 13,625 were employed on that equipment.

P.W.A. Loans to Railroad Companies and Payments Made

Railroad	Loans Allotted	Amount Paid Out
Baltimore & Ohio	$6,400,000	$3,000,000
Boston & Maine	7,318,000	3,017,000
Central of Georgia	120,000	109,000
Chesapeake & Ohio	16,876,000	8,762,000
Chicago & Eastern Illinois	240,000	240,000
Chicago & North Western	1,400,000	1,400,000
Chicago Great Western	1,200,000	.....
Chicago, Milwaukee, St. Paul & Pacific	4,033,000	3,617,000
Delaware, Lackawanna & Western	4,666,000	178,000
Erie	13,953,000	9,692,000
Grand Trunk Western	250,000	250,000
Great Northern	5,785,000	3,040,000
Gulf, Mobile & Northern	1,216,000	340,000
Illinois Central	12,000,000	8,000,000
Interstate	250,000	210,000
Kansas, Oklahoma & Gulf	255,000	255,000
Lehigh Valley	2,600,000	2,000,000
Lehigh & New England	1,212,000	1,212,000
Maine Central	313,000	313,000
Midland Continental	36,000	.....
Missouri Southern	32,500	.....
New York Central	2,500,000	2,500,000
New York, Chicago & St. Louis	5,028,000	4,030,000
New York, New Haven & Hartford	7,100,000	2,525,000
New York, Ontario & Western	235,000	235,000
Northern Pacific	1,220,000	.....
Pennsylvania	80,650,000	33,604,000
Pittsburg & West Virginia	331,000	.....
Savannah & Atlanta	250,000	.....
Southern Pacific	12,000,000	6,080,000
Wabash	1,481,000	1,295,000
	$190,950,500	$95,904,000
Balance of blanket allotment of $41,000,000 for rail purchases remaining unallocated	8,657,300	
Total amount allotted for R.R. loans	$199,607,800	

[The Public Works Administration has since announced that the number of railroad employees working in shops and rights of way on the construction and rehabilitation program financed by P.W.A. dropped from 61,500 on July 14 to 57,000 on August 25. The Bureau of Labor Statistics of the Department of Labor reported 13,625 at work on July 14 on new cars and locomotives being built in outside shops as a result of P.W.A. loans to railroad companies, and it is estimated that this number had increased to 16,000 by August 25, although reports of the actual number of men at work in their shops have not been received from the manufacturers.]

The accompanying table shows the amounts allotted in loans to individual roads for all purposes, and the amount paid out to each up to July 15. Since that date an additional allotment of $3,000,000 has been made to the Lehigh Valley for rebuilding 1,500 box cars and buying 300 50-ft. gondola cars of 70 tons' capacity and 100 65-ft. gondola cars of 70 tons' capacity, also three new Diesel-electric locomotives.

This is the third P.W.A. loan to the Lehigh Valley. The first, of $2,000,000, was made last winter for repairing and rebuilding 2,000 freight cars. The second,

New Equipment

Car Orders

Road	No. of cars	Type of car	Builder
Bethlehem Steel Co.	8[1]	70-ton air dump	Magor Car Corp.
Gray Chemical Co.	2	8000-gal. aluminum tank	General American Trans. Corp.

Locomotive Orders

Road	No. of locos.	Type of locomotive	Builder
Missouri-Southern	1[2]	Diesel-electric	Plymouth Loco. Wks.[3]

Locomotive Inquiries

Chilean State Rys.	10	4-8-4	.....
Pennsylvania	50 or 60	Electric	.....

[1] For service in Chile.
[2] This locomotive, for which a P.W.A. contract has been signed, will be a 70-ton, 500-hp., double-unit for combination road and switching service. Delivery will be made about November 15.
[3] Division of the Fate-Root-Heath Company, Plymouth, Ohio.

Only a few years ago, locomotive materials were confined to plain carbon steel, wrought and cast iron. « « « But the modern locomotive, with its higher pressures, increased speeds and greater loads, now has a wide variety of alloy steels to draw upon, many of them developed by Republic metallurgists for the specific set of conditions they must meet. « « « Today, higher boiler pressures have brought the Agathon steel boiler shell and the Agathon Alloy steel staybolt. « « « Fireboxes are built of long-life, corrosion-resisting Toncan Iron; pins and bushings of Agathon Nickel Iron; still other special alloy steels go into rods, motion work and axles. « « « Modern locomotives have their counterpart in modern materials. You wouldn't build a locomotive that is obsolete in design. Don't build one of obsolete materials. Consult with Republic metallurgists on the steels that best suit each condition of railroad service.

Toncan Iron Boiler Tubes Pipe Plates Culverts Rivets Tender Plates and Firebox Sheets • Sheets and Strip for special railroad purposes • Agathon Alloy Steels for Locomotive Parts • Agathon Engine Bolt Steel • Agathon Iron for pins and bushings • Agathon Staybolt Iron • Climax Steel Staybolts • Upson Bolts and Nuts • Track Material, Maney Guard Rail Assemblies • Enduro Stainless Steel for dining car equipment, for refrigeration cars and for firebox sheets • Agathon Nickel Forging Steel... The Birdsboro Steel Foundry & Machine Company of Birdsboro, Pa. has manufactured and is prepared to supply under license, Toncan Copper Molybdenum Iron castings for locomotives

CENTRAL ALLOY DIVISION, MASSILLON, OHIO

ACATHON STEELS

REPUBLIC STEEL
CORPORATION
GENERAL OFFICES YOUNGSTOWN, OHIO

TONCAN IRON

of $600,000, was to enable the company to purchase five new locomotives, which are being manufactured by the Baldwin Locomotive Works.

Administrator Ickes has also signed a contract for a loan of $32,500 to the Missouri Southern, the money to be used to purchase a new Diesel-electric locomotive which is being built by the Plymouth Locomotive Works. The allotment for this loan was made some time ago.

Two previously awarded railroad loan allotments have been rescinded at the request of the respective roads—one of $3,500,000 to the Escanaba, Iron Mountain & Western for construction of a concrete ore dock at Escanaba, Mich., and one of $75,000 to the Fort Smith & Western for repairs to roadway and equipment.

The Erie has been authorized to use $680,000 of its $11,282,000 allotment for equipment purchases to buy a new ferry boat for use between New York City and New Jersey. When the $11,282,000 allotment was made last winter it was expected that the 3,775 freight and 133 passenger cars to be purchased by the Erie would cost that amount. All of this equipment now is under contract and in process of construction and will cost $10,602,000. The Erie, therefore, has been authorized to use the $680,000 balance to create additional employment through the construction of the ferry boat.

Supply Trade Notes

LON R. SMITH has been appointed assistant sales manager and Charles Dahlquist and G. C. Rasey, representatives of the Hercules Motor Corporation, Canton, Ohio.

THE CHICAGO PNEUMATIC TOOL COMPANY'S Birmingham, Ala., office has been moved from 1829 South Second Avenue to 211 South Twentieth street. W. S. Lynch is manager of the Birmingham district office.

ARTHUR H. SMITH, special representative of railroad sales in the East for the Youngstown Sheet & Tube Company, has resigned to become associated with the Kerite Insulated Wire & Cable Company, Inc., in its railway sales department, with headquarters at New York.

CONSOLIDATION of the Republic Steel Corporation, Youngstown, Ohio, and the Corrigan, McKinney Steel Company, Cleveland, Ohio, was approved at meetings of the boards of directors of both companies on August 27, subject to ratification by the stockholders.

THE HAUCK MANUFACTURING COMPANY, Brooklyn, N. Y., has purchased the assets and good will of the oil burner division of the Mead-Morrison Manufacturing Company, East Boston, Mass., and will continue the manufacture of, and to stock spare parts for, rivet forges and portable torches produced heretofore by the latter company.

THE BALDWIN LOCOMOTIVE WORKS, Philadelphia, Pa., has assumed all sales and engineering of the products of its subsidiary, The Whitcomb Locomotive Company, Rochelle, Ill., and has established an internal combustion locomotive section of its sales department, in charge of H. H. Perry as manager, assisted by H. V. Huleguard. Mr. Perry was previously vice-president and general manager, and Mr. Huleguard, sales manager of The Whitcomb Locomotive Company. The new section will handle all sales of Baldwin and Whitcomb internal combustion locomotives of all sizes, and sales of electric locomotives except to public service railroads. Whitcomb domestic sales agents will continue to sell in the name of Whitcomb, and the Whitcomb plant will continue the manufacture of Whitcomb products at Rochelle, in charge of Thomas H. Mars as superintendent. Orders for repair parts, and the servicing of Whitcomb products in the field, will be handled at Rochelle by L. W. Wrenn as Baldwin sales correspondent.

JOHN C. DILWORTH, for many years associated with the Dilworth Porter Company, Pittsburgh, Pa., has severed his association with that company and has joined the sales force of the Carnegie Steel Company, as manager of railway sales with headquarters at Pittsburgh. Mr. Dilworth will handle for the Carnegie Steel Company all railway specialties and supplies, a line with which he has been in close touch throughout his industrial career. He was graduated in 1905 from Sheffield Scientific School of Yale University, and also attended Shadyside Academy in Pittsburgh and St. Paul's Preparatory school. Mr. Dilworth went with the Dilworth Porter Company immediately after his graduation from Yale and for years was in the operating department of the industry, later taking up the sales end.

John C. Dilworth

WILBUR H. WINTERS has been elected vice-president in charge of operations of the American Brake Shoe & Foundry Company, with headquarters at New York. After five years on fortification construction work on the Panama Canal, Mr. Winters entered the employ of the American Brake Shoe & Foundry Company in 1916. In 1921 he was appointed assistant controller and in 1924 was transferred to the operating department as general superintendent of foundries. Mr. Winters has been active in the preparation of the Gray Iron Foundry Code, being a member of the Gray Iron Code Authority and a director of the Gray Iron Foundry Society.

C. V. KENT, secretary and treasurer of the Badeker Manufacturing Company, Chicago, has been elected president to succeed Alfred N. Willsie, deceased.

H. S. MCPHERSON, in charge of mechanical sales in the Boston (Mass.), district for the Mechanical Goods division of United States Rubber Products, Inc., New York, has been appointed manager of mechanical sales in the St. Louis (Mo.), district. Mr. McPherson has been with this company for over 15 years and prior to his Boston service held positions in the export department in Australia, South America, and the Far East. W. G. Mueller, salesman with the company for more than 25 years chiefly in the Connecticut territory, has been promoted to manager of mechanical sales, Boston branch.

Obituary

R. J. HIMMELRIGHT, vice-president of the General Refractories Company, New York, died on August 30 in a hospital at Perth, Ontario. Mr. Himmelright was born at Wadsworth, Ohio, 51 years ago and was graduated in 1908 from Purdue University with the degree of mechanical engineer. While at Purdue he specialized in railroad work and following his graduation entered the service of the Lake Shore & Michigan Southern as a special apprentice. He then entered the service of the Locomotive Stoker Company as mechanical expert. In 1913 he became a traveling engineer in the employ of the American Arch Company and subsequently served successively as assistant to the manager of the service department and manager of that department until March, 1918, when he was elected vice-president in charge of the service and road development work in the United States and Canada. Mr. Himmel-

R. J. Himmelright

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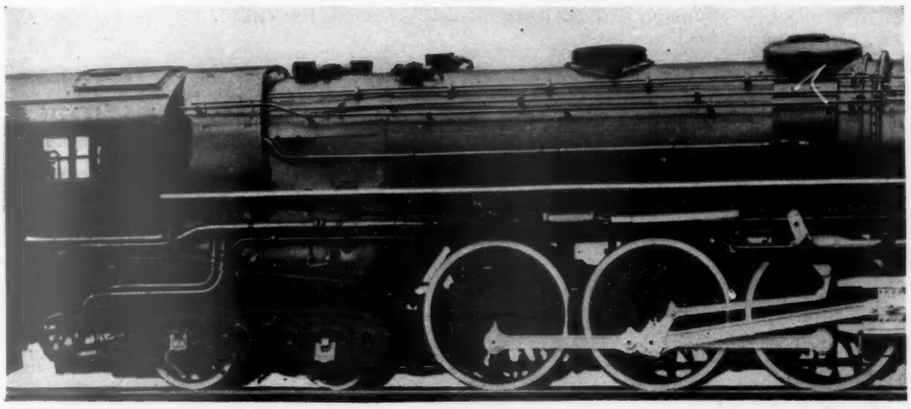
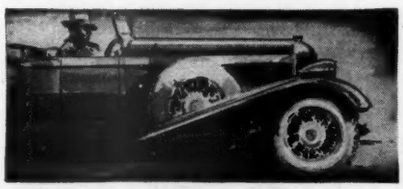
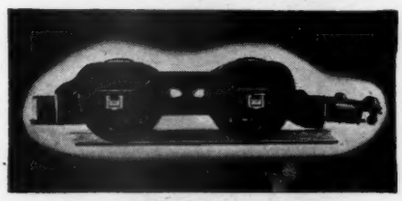


The *Double* Power Locomotive



If you could shift your locomotive into low at starting, the way you do your car, you could reduce the size of cylinders and save a lot of locomotive weight



and maintenance. • In effect the Booster does this. It provides the extra "pull" in starting that permits use of smaller cylinders. • Smaller cylinders naturally mean

lower maintenance due to a reduction in the amount of work done. • This saving in itself is more than enough to justify application of The Locomotive Booster. • Build better, not bigger locomotives.

Booster repair parts made by the jigs and fixtures that produced the original are your best guarantee of satisfactory performance.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

right left the service of the American Arch Company in 1927 and was one of the founders of the railroad department of the General Refractories Company, having served since that time as vice-president of that company. He also represented, as manufacturers' agent in the Eastern part of the United States, the Wilson Engineering Corporation, the Illinois Railway Equipment Company, the Standard Car Truck Company and the Graham-White Sander Corporation. He had for many years taken an active part in the affairs of the June conventions at Atlantic City, N. J., having served as a member of the executive committee of the Railway Supply Manufacturers' Association, and was a member of a number of clubs affiliated with the railroad interests.

ALFRED N. WILLSIE, president of the Badeker Manufacturing Company, Chicago, died in that city on August 16.

ANDREW C. WOODS, Chicago representative of the Union Spring & Manufacturing Company, Pittsburgh, Pa., died on August 24.

JOHN A. TOPPING, formerly from 1906 to 1930 chairman of the Republic Iron & Steel Company, died in his home at Greenwich, Conn., on August 24, at the age of 74.

Personal Mention

General

S. M. SADLE, a locomotive engineer on the Chicago, Burlington & Quincy, has been appointed to the newly-created position of system fuel supervisor, with headquarters at Chicago.

Master Mechanics and Road Foreman

W. L. BOGGS has been appointed road foreman of engines of the Erie, with headquarters at Meadville, Pa., succeeding F. M. Steele, retired.

A. R. MANDERSON has been appointed assistant master mechanic of the Delaware, Lackawanna & Western, with headquarters at Buffalo, N. Y.

M. A. QUINN, master mechanic of the Delaware, Lackawanna & Western at Binghamton, N. Y., has been appointed master mechanic, with headquarters at Buffalo, N. Y., the motive power and equipment departments of the Buffalo and Syracuse and Utica divisions of the Lackawanna having been consolidated.

Car Department

R. E. MAUCK, car foreman of the Union Pacific at Kansas City, Kans., has been promoted to the position of repair track foreman, with headquarters at Denver, Colo.

W. A. COOLING, repair track foreman of the Union Pacific, has been appointed general car foreman, with headquarters at Denver, Colo., succeeding P. J. McNamara, retired.

Purchasing and Stores

R. D. LONG, general storekeeper of the Chicago, Burlington & Quincy, with headquarters at Chicago, has had his jurisdiction extended to include the reclamation and scrap dock at Eola, Ill., the concrete plant at Montgomery, Ill., and the tie and timber preservation plants at Galesburg, Ill., and Sheridan, Wyo.

Obituary

MELVIN R. COUTANT, former master mechanic for the Ulster & Delaware at Kingston, N. Y., died at his home in that city on August 15, after a brief illness. Mr. Coutant had been in the service of the Ulster & Delaware for approximately 30 years, having retired from the position of master mechanic when the road was taken over by the New York Central.

GRANT HALL, vice-president of the Canadian Pacific, died on August 29 at the age of 71. Mr. Hall had been taken to a hospital a few weeks ago after suffering a stroke. He was born in November, 1863,

Grant Hall

at Montreal, Que., and attended Bishops College and School, Nennoxville, Que. He entered the service of the Grand Trunk in 1883 as apprentice machinist at the Point St. Charles shops, Montreal. In 1887 he became locomotive foreman for the Canadian Pacific and in 1893, general locomotive foreman for the Inter-colonial at Moncton, N. B. In September, 1898, he returned to the Canadian Pacific where he served consecutively as general foreman, first at the McAdam and later at the Winnipeg shops; master mechanic of the British Columbia division; assistant superintendent of motive power, eastern lines, and superintendent of motive power and car department, western lines. In November, 1911, he became assistant general manager of the western lines, and in January, 1913, was appointed general manager of the same lines. Mr. Hall became vice-president of the C. P. R. in October, 1918. He was also president of the Dominion Atlantic, the Quebec Central and the Algoma Eastern.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

ALUMINUM PAINT.—Aluminum paint—its uses and application in a wide diversity of fields, including the railroad—is discussed in a 62-page booklet issued by the Aluminum Company of America, Pittsburgh, Pa.

PIPE THREADING AND CUTTING MACHINE—The Landis Machine Company, Waynesboro, Pa., gives in folder form information concerning the "Little Landis" pipe threading and cutting machine for jobbing and maintenance threading.

BEARING BRONZE.—The Aluminum Industries, Inc., Cincinnati, Ohio, has issued a bulletin in which Permite leaded phosphor bronze bars for lathe or screw-machine production are discussed. These bars are available in all standard bearing alloys and in 6-ft. or shorter lengths; diameters, 5/8 in. to 2 in. by 1/16-in. steps.

HARNISCHFEGER ANNIVERSARY.—A review of its past achievements and some rededication of its facilities to the future are presented in an attractive booklet of 84 pages issued by the Harnischfeger Corporation, Milwaukee, Wis., in commemoration of its fiftieth anniversary.

PRESSURE REGULATORS AND REGULATION PROBLEMS.—"Oxyacetylene Welding and Cutting Pressure Regulators and Regulation Problems" is the title of the new 16-page booklet of the Air Reduction Sales Company, 60 East Forty-Second Street, New York, which contains a study of the various standard types of regulators and of the difficulties and problems which led to the development of the new Airco types, several of which are shown in cross section.

USS HIGH-TENSILE STEELS.—Two interesting booklets on the characteristics and uses of USS Cor-Ten, USS Man-Ten and USS Sil-Ten have been issued by the United States Steel Corporation. The first of these high tensile steels for light-weight construction is a low chromium copper silicon steel; the second a medium manganese steel, and the third a strong structural silicon steel. The names selected to designate these steels are partially indicative of either the individual characteristic or the predominating chemical element; For example, "Cor" denotes high corrosion resistance; "Man," manganese; "Sil," silicon, and "Ten," high tensile strength. These booklets can be obtained from any subsidiary company of the United States Steel Corporation.